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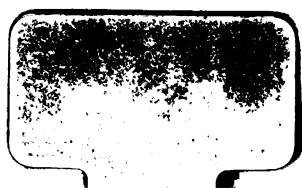
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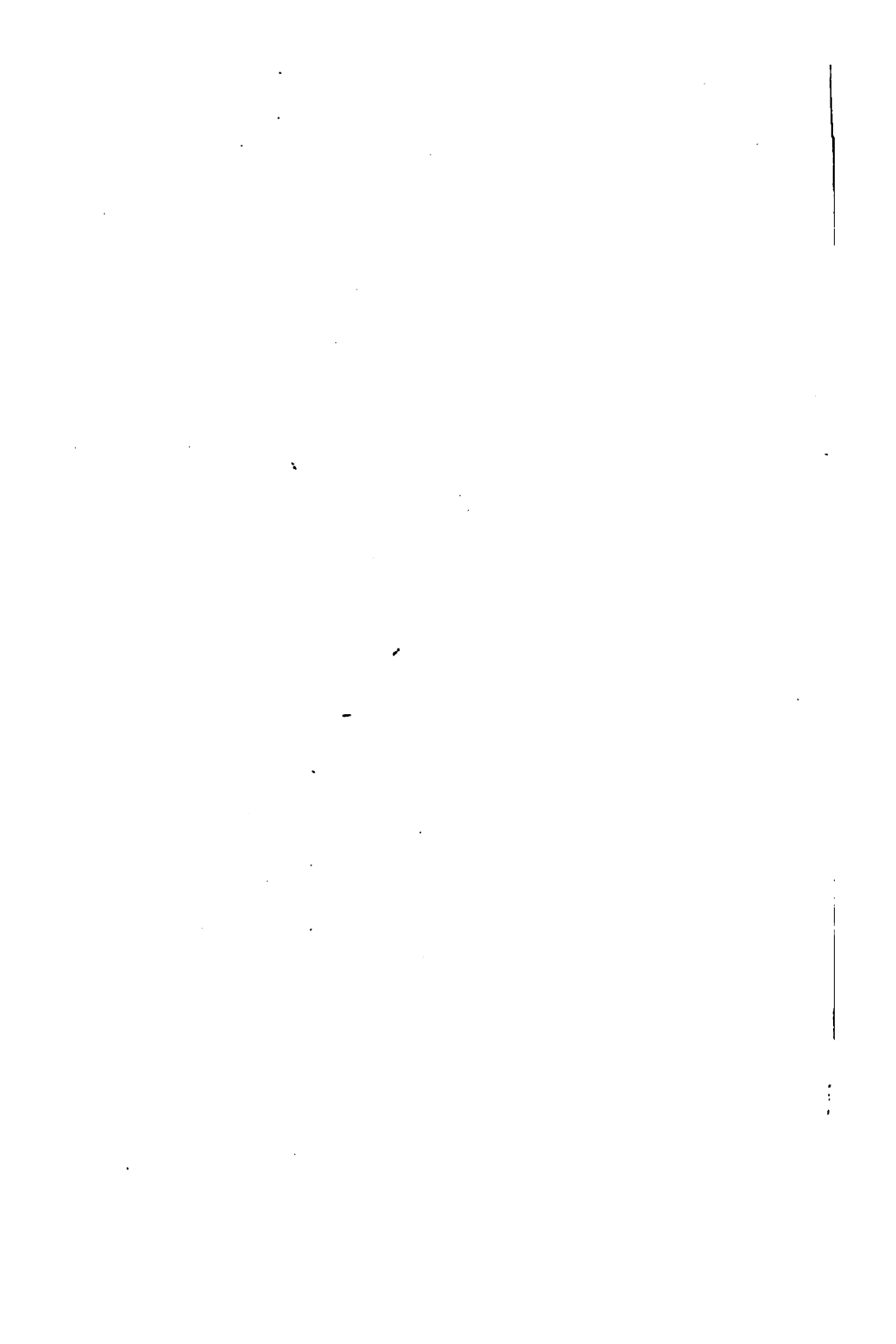
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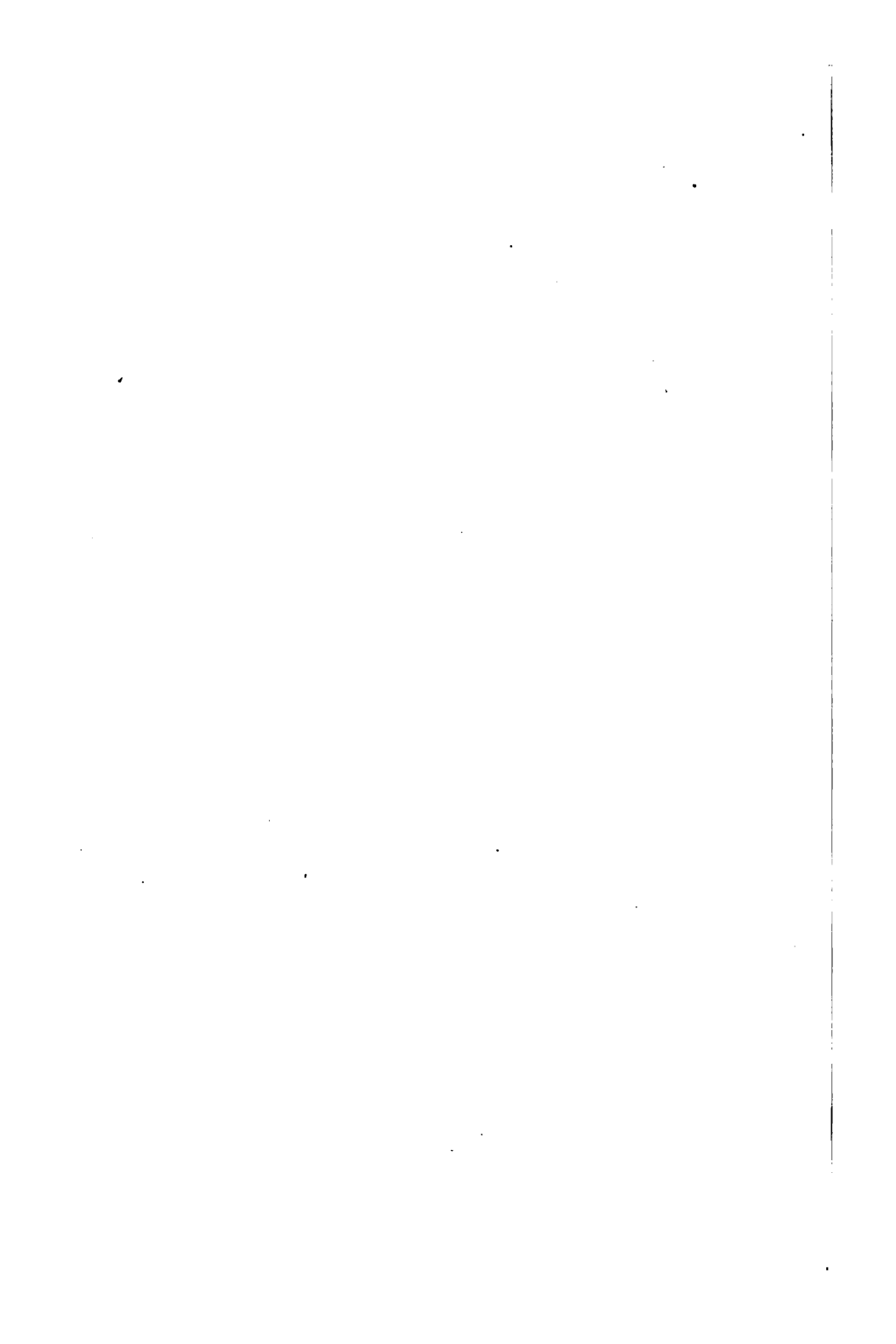
A NEW THEORY  
OF THE  
SOLAR SYSTEM







A NEW THEORY  
OF  
THE SOLAR SYSTEM.



THE  
SIMPLICITY OF THE CREATION;

OR, THE

*Astronomical Monument of the Blessed Virgin.*

A

NEW THEORY OF THE SOLAR SYSTEM,

THUNDERSTORMS, WATERSPOUTS,

AURORA BOREALIS, ETC., AND THE TIDES.

DEDICATED TO HER

BY

WILLIAM ADOLPH.

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184. C. 1.



## DEDICATION.

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WHEN works are dedicated to other parties, it is done because they have shown some act of kindness, of friendship, to the author, have taken him by the hand, and nursed him under their protection, or are by him loved and respected.

I cannot boast, that, in the progress and development of my new theory of the solar system, I have had help from friends, or the great, or learned ones of mankind; but it pleased God so to direct my thoughts and change the proposed end of a business speculation, as to lead to the result of my discovering and propounding “the Simplicity of the Creation.”

In the subsequent pages I have shown how God created matter, to which He gave laws and properties; that He created no forces, because He alone is *the* self-acting force Himself, and that this self-acting force is exercised by Him then only, when He supersedes, abrogates, or suspends those laws which He laid down at the creation; and here I have the gratification of stating, that, with regard to the latter, besides many other favours, the singular proof and privi-

lege has been bestowed upon me and mine, through the intercession of the Blessed Virgin, and by a special act of divine goodness, of seeing one of the laws of nature superseded in my own house. And hence my dedication.

It is now more than six years since my dear wife has been ill. During that time, up to the 8th of December, 1855, she had been two years without the use of her legs; she could neither stand, walk, nor lift up her legs by herself when letting them hang down from the chair or sofa on which she might be reclining; and it was my daily office during these two years to carry her in my arms from the bed to the sofa and from the sofa to the bed. Often she said, that if God would but give her the use of her legs, she would willingly suffer.

Thus the grand festival of the proclamation of the Immaculate Conception was approaching, when a novena, or nine days' prayer, to the Blessed Virgin was to be made. Her confessor, the Rev. Daniel Gilbert, had promised to offer up the Holy Sacrifice for her on that memorable day, and the evening before asked all his penitents to offer up their prayers and holy communions for his intention, which he gave to my dear wife. The 8th of December, 1855, arrived; but for her no signs of improvement. "The festival has done you no good as yet," I said to her in the morning, upon which, full of suffering, she replied: "God is

very good; if He choose to do anything, He can do it still, the day is not yet over. About 6 o'clock in the evening, sitting on the sofa, she observed to me: "Had we not better say some prayers?" to which I replied, that we might as well finish our novena. Upon this I knelt down at the little table by her side and finished the prayers, to which, from pain, she was hardly able to pay any attention. After I had got up I saw her pray very fervently by herself, intently looking upon a picture of the Assumption on the wall opposite to her, when all at once she said: "Thank God, I can walk again!" and with these words she got up, walked to the picture (and myself following tremblingly behind lest she might fall), gave thanks to God and the Blessed Virgin for the favour bestowed upon her, and went back again to the sofa. Since that time, though continuing to be afflicted with illness more or less trying, she, notwithstanding, never lost the use of her legs again.

Whether, in this instance, God restored to her the use of her legs by a natural law, or by a special exercise of His omnipotence, by a supersession of the natural order of things: it is always *He* who accomplished it, He who allowed and allows the law of grace to supersede the law of nature; and in this instance He granted it through the evident intercession of His Blessed Mother.

May then this token of gratitude to our heavenly Mother

be acceptable to her and to Him who created her for us; may this monument travel far and wide to spread the beauty of her name, and wherever the starry sky is beheld and explored by the human race, may (not overlooking the Star of the Sea), "generations and generations still call her Blessed," and experience the efficacy of her powerful and never-failing intercession like

THE AUTHOR.

## PREFACE.

---

MANY years ago I became acquainted with a foreign architect, who possessed a perfect knowledge of ventilation, although personal peculiarities prevented his success in life. By my intercourse with him, his science of ventilation became my own, and I am only sorry that it lies beyond my sphere to carry it into practice.

The science of ventilation requires an intimate knowledge of the nature of the air and its movements; and stepping beyond ventilation I was first led to my new theory of the tides, of sound, thunder, &c., several articles from me on these subjects being kindly allowed space in the columns of the *Builder* of 1851 and 1852. From that time each one of these subjects began more and more to develop itself in my mind; and though I had scarcely any time to devote to scientific pursuits, save now and then, the fruit began to ripen by degrees, until it dropped upon paper in the shape of the "Simplicity of the Creation." It has been a work of love, the brightest ideas often coming across my mind when I ought and thought to have been buried in devotion; and thus I lay it before the world as the product of an amateur in science, as one who cannot claim it as the result of his own learning or capacious intellect; and I therefore trust it

will be received with indulgence, and judged and criticised with kindness. It is true, I have taken a dogmatic stand; but this is inseparable from the conviction, whether true or not, of a good cause; and though I speak as if I were positively convinced of what I advance, yet I am far from presuming to say, that my New Theory of the Solar System is absolutely true, because, though simpler than the old one, God may have created all in a still more simple manner, may have arranged all in a more simple way, by more simple laws, than I have assumed to exist. But, if not true even, I still hope that my work will lead others to more successful inquiries, and open a new field to science.

I am aware that many points are wanting, many points but feebly or defectively carried out in my present work; but want of time from many causes, want of intercourse with men of science, their seeming reluctance to give an opinion of my new theory, either *pro* or *con*, whenever I have applied to them in writing, and my consequent inability of rectifying defects or objections, must plead an excuse. Thus not only left to myself, not only not assisted in the progress and development of my New Theory of the Solar System by the great, or the learned ones, of mankind, I have not even been encouraged by those few to whom I proposed to read, or who were condescending enough to read my MS. in some of its stages. The one did not think it of a character likely to be received by the Royal Society, but gave no opinion of the system; the other thought they (scientific men) were satisfied with the old system, as they could calculate everything

in astronomy; a third evaded my request to read the MS. though exceedingly kind to me; judging only from the little precursor which I published in 1856, a fourth, in one of the weekly papers, declared it one of the most remarkable productions that could well be imagined, and absolutely dangerous to those possessing but an imperfect acquaintance with science, whilst but few who had attended lectures on mathematics at any college would coincide with me; the fifth had read a great part of my work, admired the vastity of physical knowledge embodied therein, but considered it too difficult to treat of the subjects agitated in my MS. in the present state of science; thought a work of this kind would not be well received by scientific people, and (yet anticipating its publication) advised me to leave out the religious part of it.

Thus, not only without help, but left in the dark respecting the actual merits or demerits of my theory, I have nevertheless had a few tokens of approbation from others, though non-professors of astronomy, to cheer me on.

Judging merely by the above-mentioned little precursor of my work, the one kindly wrote "that he saw many things in it with which he could agree, and much vigour and originality of thinking;" the other was satisfied "that my theory was ingenious and truthful, that it would astonish the world indeed, if I succeeded, as he thought I should, to account for the phenomena of the universe on my hypothesis." Providing for the proofs of some of the facts, a third, most eminent, though not professed, authority, considered my

theory *simple and complete* ; a fourth would be happy to see my theory acknowledged, though it threatened to give the go-by to a mass of painfully-acquired learning ; the fifth, the head of one of the largest colleges in Europe thought very highly of the MS. (though still imperfect), and so did the party who sent it to him.

All this, the absence of censure, which I consider the highest encomium, my own conviction of the untenability of the old, and the utmost probability, if not certainty, of the truth of my new system, had fixed my mind upon its publication ; but a singular incident confirmed me in my resolution, particularly in regard to my intended dedication.

Whilst my MS. was in the hands of the astronomer, who, about three months later, advised me to leave out the dedication and other semi-religious expressions, I was travelling in Tyrol in the month of March 1858, and through the kind introduction of his Eminence Cardinal Wiseman to his Lordship, John Nepom. Tschiderer, Bishop of Trent, obtained permission to see Maria Mörl, the estatica at Caldern, with whom England was first made acquainted by the pious Earl of Shrewsbury about twenty-five years ago.

When with the Pater Provincial of the Capuchins, her confessor, and three women of the country, I entered her apartment, she was in ecstasy kneeling on her bed. Being recalled into the consciousness of this world I recommended myself and all mine to her prayers, and her face lit up with a peculiar delight when I told her of the miraculous event which happened to my dear wife. Whilst I was talking

before her to her confessor, I heard the rustling of clothes, and looking up, she was already on her knees again fixed in ecstasy as before. I had one more request to make of her, and so the good father recalled her again from her communion with God. "Will you, Miss Maria,"—I said to her, "pray for me, that I may succeed in the monument which I wish to erect to the Blessed Virgin Mary?" to which (as she is dumb to all except her confessor) she repeatedly nodded a most cheerful consent. Her confessor, however, asked, "What monument?"—to which I replied: "Not one as usual;" and turning to her almost at the same moment she smiled at me so significantly, making at the same time with her right hand a sign of writing, that I understood her at once to know that the monument I meant was a written one.

Now, though this is no test of the work itself, yet I took and take it for granted, that I am doing right and something pleasing to God, who gave her this supernatural knowledge of a written monument in honour of that sublime and exalted model of womankind, the B. V., whose "Magnificat," although not with our affection, now even resounds still in the cathedrals of the Anglican Church,—if I publish the whole work as it is, without any shrinking as to what may be said of it, as I love to think and to acknowledge myself one of *Her* seed, one of *Her*—I hope, accepted—children. The dedication, then, is a thing personal to myself, an act of gratitude, which will be respected by generous minds, though they may differ; but the work itself, with all its faults or

shortcomings, is launched forth into a world full of contention, to be perfected or torn to pieces, and must stand or fall on its own deserts. I do trust however, that, though crude, the foundation and outlines of the monument are good, and that by the truly learned and well-disposed it will by degrees be more clearly and distinctly developed, and its form and features assume all that comeliness and beauty of aspect with which master-hands are able to endow it; that it will expand over the whole globe, and, in return, still more unfold the power, wisdom and goodness of God in His creation, as well as the favours and blessings He has bestowed upon His children.

Before passing over to my New Solar System I beg to observe, that, in order to facilitate the comprehension of my new theory, the reader must picture to himself the whole universe turned over from its present representation, in such a manner, that the ecliptic, or zodiac, appears to him vertical, like a hoop, like a ring of brilliant stars, standing upright and encircling our solar system, and the planets rolling and revolving underneath between it and the sun, in progressive order and elevation, instead of ecliptic and planets lying horizontally in a plane to our solar centre, according to the theory of Newton.

THE AUTHOR.

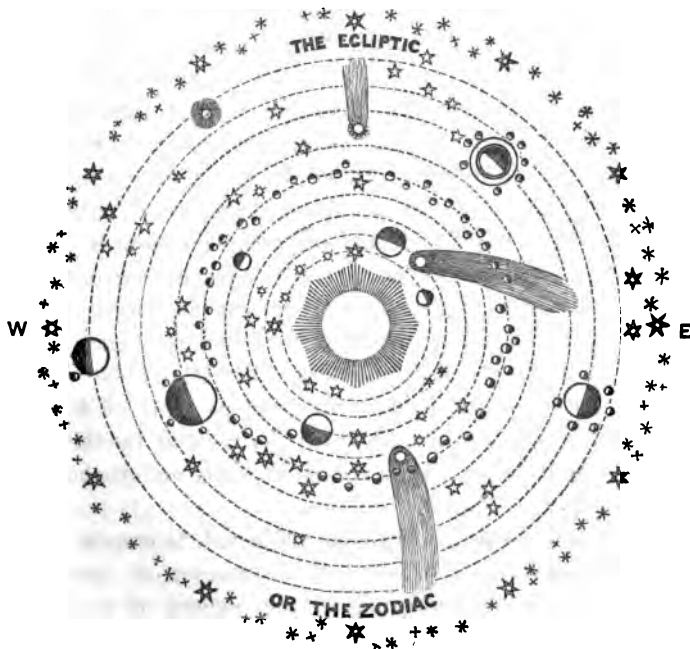
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THE  
NEW THEORY OF THE SOLAR SYSTEM.

SIMPLICITY THE CHARACTERISTIC OF TRUTH.



**EVERYTHING** had a beginning; God alone had no beginning, and has no end; He exists from eternity to eternity, and He alone fills all eternity. What He created, He created out of nothing, because nothing existed but Himself. Out

of this nothing He created spirits, the spirits of angels and of man; and of all things created, these spirits are next in degree to God.

He also, in the beginning, created heaven and earth, laid the foundation of all the heavenly bodies, as well as of our terrestrial abode, that is: He created visible and invisible matter, ponderable and imponderable substances, which He moulded according to, and into the instruments of, His divine will, and which He endowed with certain properties to carry out His wonderful designs; and these instruments, thus endowed, produce the effects which we witness in nature. God created material causes, instruments, as I have said, to produce effects; but He did not create effects, or abstract, self-acting forces, whether these forces be centripetal or centrifugal, attractive or repulsive, moving or reposing. Forces in the abstract He *could not* create; effects He *could not* create; without creating substances, instruments, by which forces are exercised, and effects produced, forces themselves are nothing but so many immediate and direct operations of the divine omnipotent will, without the instrumentality of matter; their exercise, independent of matter, unconnected with the means which He created for the production of effects, is a *property of His own*, an attribute of His divinity.

Matter and its properties God subjected to certain laws; matter, properties, and laws, He continues to preserve, sustain, and direct according to the objects of creation; through these, and by their means, He operates; and hence we may say, that, in the ordinary course of nature, God does not act by mere abstract forces, that He does not act in a direct and special manner, but that the operations of nature proceed from material causes which He created, and which He continues to wield and to sustain.

God rested on the seventh day of creation; hence we may conclude that He operated but once materially, that forces went out from Him when He created and endowed everything with certain properties. When thus the clock-work of creation was finished, He only, by a further direct exercise of force, though without trouble or labour, set the pendulum in motion; and it is the pendulum of preservation and compensation alone which, by His persevering will, He continues to maintain and to guide; but He does not in a direct manner, by an abstract centrifugal power, turn the wheel of the earth on its axis, or by direct impulse waft it round the sun. If the earth rotates on its own axis and revolves round the sun, He causes it by some material means, but not independently of these means, the instruments designed for this end; if flowers bloom, the fields become green, and forests put on the garb of spring, it is not by the exercise of God's power in the abstract, in a direct manner, by which all this is brought about, but by the instruments of electricity, oxygen, carbon, and other substances which He devised and organized for the purpose; and thus it will be seen, that the exercise of force or forces in the abstract emanates from His omnipotent arm in a direct manner, unconnected with matter, then only, when He creates, or when He suspends, abrogates, or supersedes, any of those laws or properties, which He impressed upon all matter and bodies at their creation; or, in a few words, when He performs, what is called, a miracle. Hence also, all calculations made upon the assumption of mere forces, must necessarily be false, unless based upon the substances, the instruments from which these forces proceed; for, upon the attributes of God, upon the exercise of His omnipotent power or will, the force, for instance, with which He is said to have projected the earth into space, no astronomical calculations can be

made. The fallacy of calculating the centre of gravity of the planets as at a distance from the centre of the sun; of calculating the centre of gravity between the earth and the moon to lie, not only at a considerable distance from the earth's centre, but even outside the earth altogether, in the air, in the ærial or ethereal space between earth and moon, and this ærial centre of gravitation moving of necessity round the earth as the moon progresses around it in her orbit; and of calculating the amount of abstract attraction of the sun and the moon upon the waters of the earth to produce the tides, will hereafter be made apparent.

When God, in the beginning, had created heaven and earth, substances visible and invisible, ponderable and imponderable, electricity, in its twofold nature, as the binding and repelling agent of creation, had also been called into life, and with its first quivering and quickening motion chaos began to tremble, to sunder, and matter to conglomerate according to His design. Silently and, as it were, unconsciously, negative electricity principally allied itself to matter in order to form ponderable bodies, which, at the same time, it repelled from each other like so many drops of water falling from the cloud; positive electricity expanded the more, chiefly to keep company with imponderable substances, and to embrace the nascent systems and constellations, until magnetic worlds—inclosing within their womb the kernel, the germ of their own foundation, the *fiat* of the Eternal Word—were moulded into shape, the Spirit of God moving over the dark, formless, and silent deep.

When, in their circular course, the currents of air and water flow from the equator to the poles, and from the poles to amalgamate again at the equator, so the electric elements. Thus, when the separation of negative from positive electricity had in part been accomplished by their respective incorpora-

tion and alliance with solid, fluid, and gaseous matter; when the growing worlds began to manifest the polarity of their bodies, and the electricity of the sphere of the universe had accumulated at its poles to overflowing, God said: "Let there be light!" and it was so. Instead of dissipating beyond the sphere limited by God, the electric accumulation of the poles, at His command, returned again to the centre of the universe; positive and negative electricity for the first time met for mutual embrace in chemical recombination; all became active with life; a spark, and, in the twinkling of an eye, all was light; light, the fruit, the product of reunion, suddenly shone over the whole creation; darkness retired away from the face of the illuminated centre to hide in the shade of the heavenly bodies; toward the centre all was bright, away from it all became dark; and as the systems began to separate and to move within the electric globe of the universe, light and darkness in succession passed over the surface of their bodies during their systemal revolution.

When the immeasurable space of creation was lit up, and light first fell upon the faces of the electric worlds,—which, as it were, in anxious expectation of approaching animation, inclined towards their common centre,—they began to breathe like the child newly born; light had given motion to the element within, and it broke forth in copious exhalation. The separated electricities within and without also endeavoured to unite; they strove, in a manner, for mastery over the as yet unapportioned and undisposed of vapours, gases, and solutions that still hung over the abyss of the deep; and as their contending activity both contracted and precipitated, decomposed and distended the substances coming under the influence of their recombination, their first, and most likely unresisted effort at amalgamation augmented to a greater degree still the light shed upon created worlds from within.

the space of the universe ; and their shaded sides even, during that long systemal revolution, shared in that glimmer of light which is never absent from us in a clear, though starless, night, and which always, more or less, is attendant upon the union of the opposite electricities when free and unaccumulated.

Thus it was that the first evening of the world had been ushered in ; it lasted until systems had performed a revolution round their own respective axes, or the globe of the universe itself having accomplished, perhaps, a revolution round its own centre ; and this first long evening, with the morning that preceded the second day of creation, were with God as one day, during which, light and darkness passing once over every part of the orbs moving with their systems within the revolving creation, the electricity within them continued to attract the chaotic particles of water and superincumbent elements, until, as unfolded to us by geology, each stratum in succession was formed according to the attraction exercised upon the various kinds of matter ;\* and thus these orbs were moulded and consolidated within the deep for the ulterior occupation and benefit of those beings who were to inhabit them.

No suns having as yet been enkindled in the vault of

\* Respecting this deposition of matter, Sir David Brewster says, in his "More Worlds than One,"—"If the Almighty, then, since the creation of man, broke up the foundations of the deep, and opened the windows of heaven, and thus, by apparently natural causes, covered the whole earth with an ocean that rose above the Himalaya and the Andes, why may he not at different periods, or during the whole course of the earth's formation, have deposited its strata by a rapid precipitation of their elements from the waters in which they were dissolved or suspended? Chemical and physical forces of high activity may have been the agents in such summary operations ; and in the beautiful process of the electrotpe, we have a striking example of the influence of electricity in effecting a rapid precipitation of metals from their solutions."

heaven to divide the day from the night, but light merely called into existence to separate the light from the darkness, it was the light of evening rather, the first *Aurora Centralis Universi*, that first shone upon the airless creation. Hence, day and night are not named by the sacred penman, but evening and morning only; and the *day* of the world having commenced with the evening, he continues to introduce every subsequent day of creation as beginning with the evening; and from this, no doubt, it also arises that the Jews, the once chosen people, still count their days from sunset to sunset.

On the second day God separated, for good, as it were, the contending, yet to union-inclining electric elements, by the creation of the firmament, the non-conducting atmosphere of the earth, and probably also the atmospheres of the other planets, suns and stars of the universe. Thenceforward, heated by the gradually increased electric action of the interior, mists arose from, and floated over, the liquid waters of the earth; and by thus moistening the atmosphere, and neutralizing to a great degree the non-conducting nature of the air, the two electricities continued to 'amalgamate, and though with increased obstruction, yet at a greater distance from the earth, and within a clearer and more rarefied space; and in this manner the process of precipitation and decomposition went on as before, the same as it does now under similar conditions.

When on the third day God separated the dry land from the water, the mists rising from the earth took a higher direction, they became less with the decrease of the surface of the waters; with them, positive electricity retired still further from the solid body of our globe, whilst the negative element became more strictly confined within the ponderable spheres with which it had associated; and with this closer

confinement the heat of the exterior crust of the earth gradually decreased in proportion, whilst interior heat and activity augmented.

By the partial removal of superabundant moisture, as well as by the wider separation above the firmament from the waters below of these vapours, solutions, oxygen, hydrogen, and perhaps other gases, which as yet had not been, or were not to be, incorporated with the solid or liquid masses of the earth, the air became clarified, and began more and more to approach the state in which we enjoy it at present. Deprived, therefore, to a great degree of the moist conductor by which it had been saturated before, still more resistance had to be overcome in the union of the two electricities. This, however, was counteracted by the warmth imparted by the earth to the atmosphere; and recombining at a still more increased distance from the earth, and within a still more rarefied space than before, we may even suppose that the third day of creation was lighter than the first and the second. Land, still soft after its emersion from the deep, the absence of sunshine made good by an increase of light, the want of solar heat compensated by interior warmth and activity, and the absence of rain amply and more universally supplied by heavy dews, the earth became an electricity-exhaling and inhaling hothouse from pole to pole, to receive the Word of God, and to bring forth in gigantic forms the wonders of the vegetable kingdom.

On the fourth day of creation the mists of the earth, of the planets, and suns had still further retired above their firmaments; positive electricity likewise withdrew into still higher regions, and began more and more to accumulate at its increased distance from the attracting twin confined within the solid masses below; at the bidding of God, their tendency to unite arriving at the point of culmination, at the

highest and purest pitch of concentration, the electric envelopes of the suns broke through the charm that had bound them in slumbering action, they burst into fire, and from *simple heavenly bodies* became *lights and stars*, to shine and sparkle in the expanse of the heavens, and to behold and hold fast the inferior bodies that had nestled within their invisible bosoms. Negative electricity having drawn around itself the hardening and still accumulating crusts of the heavenly bodies; having entombed itself within their shells, like the caterpillar within its cocoon; its heart expanded with accelerated vigour, and, like the newly-born infant beginning with *living life*, so to say, its mysteriously-nourished pulsation, it bounded in the light and warmth of its glorified kindred; and it was then, in the exuberance of joy, as it were, that, having from the commencement partaken of the rotation of the ball of the universe, the worlds of creation first began to rock to and fro in the cradle of heaven; that, prepared for it by the separation of the dry land from the water, they began their individual motions and courses, and that our days and nights began to reckon twenty-four hours. For, until then there had been but evening and morning, and on earth a uniform climate, with the most luxuriant vegetation, because no lights were made to divide the day and the night, to be "for signs, and for seasons, and for days and years," such as we count them, and the light and darkness of the first (to us long) days of creation gave way to, and were absorbed by, the concentrated light and darkness of solar systems without number, and comparative repose of the heavenly bodies gave way to revolving and wandering motion. Deprived again of the bright luminaries with which creation was thus studded all over, wandering worlds again would stand still; with a dissolution of the electric element, creation itself would again return into chaos.

The universe of creation, of which God Himself is the centre, whilst, at the same time, it reposes within Him,—this universe of created things, limited within His infinite Godhead, He filled, as we have assumed, and as we shall see more particularly hereafter, with that subtle, imponderable, and elastic matter, which, as confirmed by all human researches and observations, of all substances, occupies the first rank in the gradation of created elements—electricity.

As all throughout nature everything seems to consist of two kindred elements, so electricity exists in a twofold kind; it forms two genders, and these are known and distinguished as positive and negative, the latter no doubt proceeding from the former, as woman was taken from man; and these two mysterious twin elements are, and still more will be found to be, the very life and soul, the ever-active agents, the essence of creation; they are the most expansive and the most contractible, the most subtle and most powerful, and they pervade or combine, more or less, with every substance; it is from them that proceed light and heat, expansion and contraction, attraction and repulsion, motion.

When suns had been lighted, positive electricity alone appears to have taken possession of, and filled the entire immeasurable expanse of the universe, as with a globe of cohesive and elastic fluid, beyond which there is eternal darkness, the darkness separated from the light, distended by its own expansive nature, and by all the heavenly systems poised within it, and yet tending to collapse towards the centres of attraction distributed within its unfathomable space.

Thus, God alone reigns beyond this universal ball of positive electricity; He holds it upon his hand like a precious pearl, which he turns round without effort; and within this motion of the whole universe all the heavenly systems are

harmoniously revolving, most likely round a centre of their own, perhaps round our own solar system.

To each of these systems, repelling each other like so many electrified pith-balls, the omnipotent Creator gave a centre of its own, a sun, as a centre of light and warmth, and as the point of attraction. Thus, our own sun in the centre, the electro-magnetic point of concentration of our solar system, as the earth is the centre of gravitation of everything that moves within its sphere; and in the same manner as He gave atmospheres of their own to our earth and to all the planets, so, no doubt, He gave an atmosphere to the sun, within which all the planets of our systems were to revolve in regular order and orbits, the same as the moon, no doubt, floats within our own sphere.

True, God can do anything; He can, according to the old theory, fill creation with vacant spaces, and move through them, in arbitrary positions, the heavenly bodies, by the most arbitrary laws, in any manner He pleases; the creation, however, alone was arbitrary, but the laws which govern it are simple, and only appear arbitrary as long as we do not know them. To find out these laws, to wield power over unconscious matter, and make it subject to his wants and will, is one of the noble tasks left to man; and as his success therein evidences the high position in which God has placed him upon earth, evidences that brilliant spark of conscious intelligence which is not of his own making, but which the Supreme and Eternal Intelligence infused into him from His own nature: so it glorifies and evidences that wisdom and intelligence of God, the creator and master of all matter, in man himself, in the simplicity of the creation, and in the production of so stupendous works and effects by means so simple.

When these means, these arrangements of God are truly

discovered, all becomes plain and intelligible to ordinary comprehension; they are sure not to be true laws if they present to us a theory, intricate and anomalous, and indigestible to the mass of mankind. If my theory be true, I shall feel happy to have been the humble instrument in promoting the knowledge of the simplicity of the laws which govern creation, to have propounded, and perhaps satisfactorily proved, a "*Universal Systemal Repulsion*;" and investing the sun with an atmosphere of his own, to having reduced the law of "universal gravitation" into that of "solar and planetary gravitation," by which the planets gravitate to the *centre of the sun*, and the moons gravitate to the *centres* of their respective planets; that is, all the planets, however numerous, are attracted by the centre of the sun, in whose sphere they *revolve* progressively, and the moons are attracted by the centres of the planets, in whose sphere they *float* onward. I am borne out in this new theory by Mr. Montagu Lyon Philipps, who says, in his "Worlds beyond the Earth:" "It is difficult to conceive a system, like that of the universe, to be stable without some agent to counteract gravitation. The fact of the fixed stars keeping in their relative positions so unchanged, would be inexplicable upon the hypothesis of gravitation alone." In another place he says: "Gravitation alone will not account for the stability of such (planetary) systems. The one sun must be repulsive of the other, as we have explained. Each would maintain its own *system of planets* unaffected by the other."

Nearly half the ponderable matter of our globe consists of oxygen, the vital part of the air; and this gas, on being freed from union with solid bodies, expands into a space two thousand times greater than that which it previously occupied: what space, then, would it not fill if it were released from the combination with the greater part of the crust of the earth!

The sun is, by some, considered as an ever-burning body; by some, as a body, black and cold, like our own earth, but enveloped by a luminous cloud. If we consider him as a globe of fire, what may not have been the liberation of matter when God created him, and bade him give light and life to a world! We may suppose a crust to be dissolved, whose liberated gases rose up from the surface, until they filled the space which God had assigned to them, and in which they are kept expanded by the same fiery agency, gravitating still to their centre, and, like our own atmosphere, becoming dense as they approach, and more and more rarefied as they recede from it. If we consider the sun and fixed stars as encircled by a luminous cloud, formed, as I believe, by a concentration of that positive electricity which I assume to pervade the whole universe, to transgress the limits of every solar system, to know of no barrier save the embrace of the omnipotent God: that concentration would, on my theory, manifest itself as a permanent state of sheet lightning, a constant, overspreading aurora borealis, produced by laws similar to those which operate on our own planet, as we shall have occasion to see more clearly hereafter; and this cloud of electric fire, in the same manner as if the body of the sun itself were burning, would tend to keep his atmosphere in that expanded and attenuated state in which it, beyond doubt, exists, the same as the heat of the sun himself contributes to the expansion and extension of our own atmosphere, particularly round the equator.

Of the pressure of this inconceivably rarefied atmosphere of the sun, of an atmosphere of gases gradating in wonderful affinity, in increased attenuation and elasticity from the surface of his body to the confines of his sphere, and, no doubt, capable also of transmitting light with an infinitely greater velocity than our own atmosphere, we may conceive but a

faint idea, by bearing in mind the extraordinary pressure of a little air in a bladder expanding within an exhausted receiver, so that the atmosphere of the sun forms a resisting medium, modified to the highest degree by its extreme elastic condition.

Within this atmosphere it pleased God to station the planets, invested with correspondingly elastic and resisting envelopes, to facilitate their passage through seemingly vacant spaces. And for this purpose God not only endowed them with one atmosphere of matter, but, like the sun, with a succession of envelopes of various descriptions, with ocean above ocean, as I shall prove later on, each envelope, ring, or ocean, becoming attenuated and elastic in proportion to its approaching the extremity of our sphere, and forming, as it were, an elastic web or network, that keeps the whole together.

Thus, our own atmosphere of air, ending at a calculable distance of about forty-five miles above us, would not have been sufficient, and on that account cannot terminate the extent of our sphere; for it was not only necessary to swell the bulk of the earth, as well as that of all the planets, by a more fluid, rarefied, and elastic body than the air, to keep it afloat in the atmosphere of the sun, and to lessen the effect on the solid part of it in which we live, which a passing planet or comet might otherwise exercise, but also to encircle them by a substance corresponding to the rapidity of their revolution and progression, as well as to the substance they were to move in, as it is not, and cannot be true, that the heavenly bodies should move through empty regions, without any resisting medium, without anything to support them.

That they move within a resisting medium is proved by comets, whose transparent and magnifying envelopes or atmospheres begin to form into tails, and to elongate or shorten according to the velocity of their motion and the

density of the fluid in which they move ; and this effect could not take place if they were moving in a vacuum, whatever their envelopes or atmospheres may be composed of, whatever the nature of their cohesion.

A comet approaching the sun, when seen at any considerable distance from that body, has little or no tail. The tail begins to appear when the body draws near the sun, moving with prodigious velocity ; with the proximity and velocity of the body the length of the tail increases, but does not acquire its greatest extent till after the perihelion passage ; it is then by degrees drawn in again, until, in the remote regions of the system, moving slower, the comet reassumes its spherical form.

The velocity of the comet's motion through a resisting medium changes its hair or nebulous envelope into a tail, which becomes expanded or contracted in bulk according to the distance from the sun and the consequent immersion into a more dense or more attenuated atmosphere ; and it is this expansion and contraction, with the elongation and shortening of the tail, that causes the excentricity of the comet's orbit. Or rather, destined, perhaps, to carry light and warmth, in a latent state, into the remotest parts of our solar system, to planets, but sparingly supplied by the rays of the sun, they probably pass in cycles round the sun, similar to the motion of the moon round the earth. Having given off its superabundance of light and warmth, the reduced or exhausted body of the comet is attracted by one of the polar regions of the sun, or by some place or other laid bare by the immense openings of his veil of fire ; and gravitating with ever-increasing velocity to the centre of its attraction, it is replenished with a fresh store of vitality, and its exposed nucleus endowed with renewed polarization ; and thus charged to overflowing with the bounty of the Almighty, it is repelled back again with prodigious power on its distant errand, to

reappear at some uncalculated future period, a wonder of creation, in another part of the heavens, attracted by the other pole, or some other spot of the sun, or its electric helix.

If our earth and the planets had no further envelope than an atmosphere of air, or that the higher rings of oxygen, hydrogen, or whatever else it may be, were not of so highly cohesive and elastic a nature, the earth and planets would not appear as spheres to our eyes; but the rapid progression of the earth through the resisting medium of the solar atmosphere would drive back into a tail our ocean of air and water, already so easily acted upon and lashed into fury by a slight pressure of the moon, and by a mere accumulation of thunderclouds, as we shall see hereafter. It, therefore, is not only probable, also, but absolutely necessary, that superior envelopes of our earth should exist, in order to guard us against exterior pressure, whether caused by the rapidity of the earth's progress in the solar atmosphere, or by passing comets or other heavenly bodies, should they come within our vicinity.

Hydrogen, as the best reflector of light, the lightest or most expanded of all known gases, is admirably calculated to form one of the outer, if not the last, envelopes of our globe, as, owing to its expansion, it is capable of that resistance which our earth requires for protection in its rapid course through resisting matter. Our sphere, surrounded by an invisible web, and pressed upon on all sides by the atmosphere of the sun, we may not inaptly compare, as I have done already, with a balloon filled, in our own instance surrounded, by hydrogen gas. In the great Vauxhall balloon it has been calculated—the air pressing with a weight of 15 lbs. to the square inch—that when inflated with this gas, it sustains upon its external surface the enormous pressure of 9,122 tons. And such an envelope of gas is actually

required for our globe to resist the pressure of the atmosphere of the sun, and to ward off from us the effect of a progressive motion through the heavens of 68,148 miles an hour, or 19 miles in a second,—in the mere twinkling of an eye.

Whether, thus surrounded and protected, like the yolk by the white of the egg, the planets, as fiery balls, rose up from the body, and with the expanding atmosphere of the labouring sun, ascending to their designated positions, there to cool, and by degrees to form each one a world for itself, some of them generating and throwing up in a similar manner the satellites by whom they are accompanied; or whether, with the grand luminary that attracts them all, and bestows upon each of them the blessings of light and warmth, they were dropped from the bosom of the Almighty like soap-bubbles from the mouth of the child: His unerring and immutable wisdom provided them all, like the sun himself, with electro-magnetic hearts of intense, unquenchable fire, to fill AND WARM THE WHOLE OF THEIR FRAME, by infusing into them from the beginning the negative electric element, to grow and enlarge together like the body with the soul; and He weighed and adjusted its quantity, in proportion to their size and density in so admirable a manner, that, when the sun began to revolve upon his course, they also began, like so many balloons, inflated, in a manner, by the breath of Omnipotence, to float and revolve with mathematical precision, certainty, and regularity, in their prescribed orbits, in his track, and within the atmosphere of the solar system.

Positive electricity, which I have assumed to pervade the whole universe, accumulates round the heavenly bodies according to their own interior electric constitution; they attract and repel each other on their approach by this very accumulation, though kept apart already at their respective distances by the position they occupy according to their

inflation and specific gravity; but, by surrounding and isolating each of them by an almost non-conducting element, by a transparent veil placed between the magnet and the magnetized object, it was alone possible to keep each planet confined to the place and path assigned to it by God, to restrain within their limits the two kinds of electricity, which always tend to unite, and also to bring together the bodies from which they emanate.

By this isolating veil of our atmosphere of air, this union, this approximation, has so beautifully been guarded against by Divine Providence, that, by the exquisite distribution of exterior, that is, solar heat, of water and air, just so much of negative electricity is liberated from each planet (if our earth be a pattern of all), and just so much of the positive fluid allowed to penetrate and accumulate within the upper regions of the atmosphere, as, by amalgamation in the phenomenon of lightning, and its accompanying thunder, and the aurora borealis, &c., will be a blessing to the beings by whom the planet is inhabited, each one of the electric elements returning most likely again, in some manner or other, by a compensation veiled in mystery, to its original destination.

I will now try, from natural phenomena, to prove the material points of my new theory of the solar system; namely, the existence and operation of positive electricity exterior to the solid part of the heavenly bodies, and of negative electricity confined within them.

That these two kinds of electricity have a tendency to unite is a well-known matter of fact. Positive electricity becomes permanent when we arrive in the upper regions of our atmosphere, increasing in body and intensity the nearer we approach the sun; negative electricity is permanent in the earth and its waters, increasing in body and intensity the

nearer we come to the heart of the earth: the former is densest the colder and more rarefied the air; the latter escapes more freely from the earth, the warmer and more expanded the air becomes on its surface. Hence no thunderstorms in cold regions, or in winter; because the condition of amalgamation does not exist; that is, the cold state of the atmosphere does not allow negative electricity to escape from the earth.

In this I am confirmed by Dr. Lardner, who says: "One of the earliest results of the observation of the electrical state of the air was the discovery of the fact that, in clear weather, when the natural state of the atmosphere is undisturbed by clouds, it is always charged with positive electricity,\* and the surface of the earth is, on the contrary, charged with negative electricity.

"The negative electricity of the ground, and the positive electricity of the stratum of air contiguous to it, have a continual tendency to recombine and neutralize each other. From this cause the lowest stratum of air in clear weather, apart from disturbing causes, is found to be in its natural state. This effect extends to the height of three or four feet from the ground; above which height the positive electricity begins to be perceivable, and increases in its intensity in ascending, according to some definite law, which observation has not yet discovered." And he further states: "From the

\* Dr. Lardner assumes that the positive electricity of the air is supplied to it by the earth. But this cannot be true; for, rising from the earth, and diverging as it ascends into the ever-increasing rarefying ring of atmosphere, it is not possible that, according to the same authority, it should "augment in intensity, as the height increases, to the greatest elevation to which observation is extended." Positive electricity, therefore, must be permanent above us, decreasing in intensity in the same proportion as it has to force its way down to the earth through the increasing density of the air.

testimony of Phipps, Scoresby, Parry, Ross, and all others who have navigated the Polar seas, it has been ascertained that the frequency of thunder diminishes in approaching the pole. It appears to be certain that it never thunders in north latitudes above the 75th parallel. Between  $70^{\circ}$  and  $75^{\circ}$  thunder is sometimes, but rarely heard. Below  $65^{\circ}$  storms become more common, and their frequency increases as the latitude diminishes, the intertropical regions being those which, in general, present the most violent and frequent manifestations of this meteor."

Thus, the body of air floating on the earth is a constant obstacle to the union of the two electricities. When, however, the rays of the sun, in certain states of the atmosphere, fall particularly strong on the earth or the sea, their accumulation and intensity cause the air to expand; and in proportion to this accumulated heat and consequent expansion of the air, the negative fluid is liberated from the earth, or disengaged from the sea; it then rises all over the more than ordinarily heated surface, and, filling the air, produces in us that lassitude of body and depression of spirits which we always complain of in sultry weather. In this I am confirmed by Richter, who found that the electricity of the positive pole augments, whilst the negative diminishes the action of life: the pulse of the hand, he says, held a few minutes in contact with the positive pole, is strengthened; that of the one in contact with the negative, is enfeebled.

Whilst this depressing liberation of negative electricity takes place on the earth or the sea, the sky becomes overcast, clouds begin to form, and the positive fluid of the upper regions, floating there loosely, like its kindred below, finds in these clouds a place of refuge, into which it creeps like water into a sponge; or, in the words of Dr. Lardner, "the cloud takes the nature of one continued conductor, and the free

electricity accumulates on its surface in the same manner as on the conductor of an electrical machine." The clouds then serve as a vehicle to carry the electricity thus contracted through the otherwise opposing air, towards the object of its attraction.

During this process of concentration of electricity below and above, both kinds begin to exercise their mutual influence,—their inherent magnetic power, their property of amalgamation, their tendency to unite, having increased with their accumulation; and thus, as it were, they are brought within sight of each other, close within contact. Positive clouds begin to draw together, to unite, and to lower as they become larger and more charged; and their movements are directed, more or less, by the accumulation of negative electricity on the earth, which draws them down, as also by atmospheric currents and the face of the country. If the place of gathering be mountainous, thunderclouds will sometimes approach from opposite directions, and hover about the tops of hills and mountains, as if they would not leave them.

The electricity of the earth tending to rise, and at a certain height finding itself everywhere impeded by a denser and colder state of the air, seeks a conductor in any elevated object that may be near; and to this it leans, as it were, for assistance, and ascending into the higher strata, forms a constantly upward-flowing stream of the electricity all round. The fluid, however, will prefer such conductors as are most congenial, to which it has the greatest affinity; and the more pointed the ends of the conductors, the more readily will the stream, pushed on from below, quit its hold and emerge into the opposing atmosphere; but the rounder or larger the extremity of the conductor, the more will the negative fluid there accumulate, and the more difficult will be its passage into the resisting air.

In this manner, then, the negative electricity escaped from, and floating on, the earth or the sea, like vapours from the surface of boiling water, is directed upwards in as many volumes or streams as there are conductors, and the better the conductor, the more concentrated or condensed will be the stream; the best and highest conductors take the lead, and in most cases absorb the lower and lesser streams of the neighbourhood. On the sea, islands and ships will act as conductors, and to these the electricity floating on the surface of the water will incline. Islands, moreover, will not only attract and conduct the electricity of the water that surrounds them, but will also send up their own electric exhalations in still greater abundance.

This is confirmed by Humboldt in his "Cosmos," and also by Dr. Lardner. The former says: "When, upon the whole, where the ocean of the air rests upon a fluid bottom, the electric balance is more rarely disturbed than in the air on land; it is the more striking to see how, in extensive seas, small groups of islands influence the state of the atmosphere, and cause the formation of thunderstorms." And Dr. Lardner makes the following observation: "By comparing the recorded cases of thunderstorms on land and at sea, it appears to be established, on grounds at least of strong probability, that storms are more frequent on land than at sea; that at sea the frequency of storms diminishes as the distance from land increases; and analogy leads to the probable conjecture that there is a certain distance from land at which it never thunders." The cause of this lies in the absence of conductors to the negative electricity liberated from the water, and the consequent formation of waterspouts instead of thunderstorms, as we shall see a little further on.

On land, the chief conductors will be elevated buildings, particularly steeples with metal vanes, and the like; trees,

as also the human body, and animals in an erect position, where higher and better conductors are wanting. Hence the necessity in open fields to lie down flat on the ground in case we are overtaken by thunderstorms.\*

As regards mountains, the fluid will creep up at the sides, and arrive at the summit more and more concentrated, like many streams merging into one; and hence its power, at this elevation, to attract and arrest electric clouds.†

For this accumulation of electricity on the summit of mountains, Dr. Lardner accounts in the following way: "Since free electricity accumulates in great intensity at prominences and points of a conducting body, the negative electricity of the earth may be expected to be most intense at mountain-summits. Clouds being in general charged with positive electricity, an attraction will consequently be exerted upon them, which, conspiring with the attraction of gravitation, will draw them round such summits." The true cause of accumulation is, however, as I have stated it.

Besides this ascent of negative electricity by the sides of mountains, vapours rising from the earth will also act as conductors; charged with the electricity through which they ascend, they will form into light clouds, and rapidly take their direction to the clouds above.

\* One person is a better conductor than another, and, no doubt, one animal better than another; and this most likely depends upon the stronger or feebler process of animation, of life, upon the respective warmth or coolness, the electro-phosphoric constitution, of the body. With animals, the form of the body will probably influence the conduction of the electric fluid. If among inanimate bodies one conductor is better than another, all else being the same, it arises from the one being chemically united with more electric matter than the other.

† It will be interesting to examine what relation there exists between pine and other forests growing on the tops of mountains, and electricity and oxygen; whether wood grown on the mountain, as a rule, burns better than wood grown in the plain or in the valley.

By these means the atmosphere becomes filled with streams and volumes of negative electricity, and the stronger and higher they rise, the more will they attract and hold fast the electric clouds. Negative clouds, if but lightly charged, will swell the positive ones, and the amalgamation will take place without explosion; if heavily charged, the mutual attraction is more vehement and stronger, and the point of union of the two fluids at a greater distance between them; the positive charge passing to the negative cloud will be ignited by the friction of the air through which it darts, and the union of the clouds will be accompanied by lightning.

In the same way, when both electricities have reached that point at which their union becomes irresistible,—that distance at which the force of the electricity shall overcome the resistance of the surrounding air,—the positive will precipitate itself from the cloud towards the negative columns from the earth, ignite by friction with the air it has to pass through, and cause as many of these volumes to explode in the air, down to their very base, even into the bowels of the earth if uninterrupted, as may be dense or near enough to be capable of ignition. The almost instantaneous explosion of these electric columns rising from the earth, and often cut off from the earth by the wind or atmospheric currents, and drifting about in the air, produces the various forms of fork, or zig-zag lightning, which, according to Lardner, seldom flashes between two clouds, but is, in conformity with my theory, generally manifested between a cloud and some terrestrial object, playing about in the air like flames in the escaping gases of a coal fire.

Lightning-flashes sometimes dart upwards from the cloud; and this takes place when volumes of electricity rising from the earth ascend higher than the position of the thunder-cloud hanging in the air. If such a volume be struck by a

flash from the cloud, it is natural that it should explode to its extreme point, whether this be the summit of a mountain or the top of a steeple. An instance of this kind is cited by Dr. Lardner (ii. 127), where seven persons were killed on a church, erected on a lofty peak in Styria, by a flash of lightning ascending from a cloud about half the elevation below the place where they stood.

In all cases, where resistance of the air to the amalgamation of the two electricities in their accumulated state is not sufficient to cause ignition,\* the union will take place without the appearance of lightning, and the affected column, or volume of electricity,—the thunderbolt as it is called,—will strike with the same destructive effect, though without the fire; no such effect will result, however, if the two electricities are not sufficiently dense for the purpose.

The heavier a cloud is charged with electricity, the blacker will be its appearance; magnetism, or its property of cohesion, will hold the fluid together in as compact a body as possible, and consequently, the vapours of the cloud are contracted, with the charge they contain, into a much denser body than otherwise would be the case; and there is no doubt upon my mind but that the rays of the sun falling upon, and being absorbed by, the cloud, must exercise some material influence on its condition and development.

In the absence of clouds, on fine, clear, and calm summer days, the electric columns from the earth will rise to a great

\* The distance at which the explosion will take place, and its force, will depend on many circumstances; such as the difference between the actual charges of the clouds, and the charges due to contact, the form of the clouds, and the state of the intervening atmosphere. An electrical explosion, therefore, may take place between two clouds, whether they are both similarly electrified (if unequally charged), or one be electrified and the other in its natural state.—LARDNER.

height. On arriving in the upper, highly rarefied regions of the air, whether cut off from, or still connected with, the stream from below, they will amalgamate with the free, yet more than ordinarily attracted and consequently dense positive electricity above: this amalgamation is accompanied by an evolution of light, and, by a rapid exhaustion and supply from above and below, produces the sheet lightnings of our summer evenings. For, light alone is evolved by the two electricities when their union takes place within a rarefied atmosphere. This is proved by a very beautiful experiment described by Dr. Lardner. Let a Leyden jar be suspended under the receiver of an air-pump in a dark room, and let the air within the receiver be slowly and gradually rarefied by the action of the pump. When the internal fluid is sufficiently relieved from the restraining pressure of the air, it will be seen to overflow the mouth of the jar, and descend the sides in a cascade of light to meet and combine with the external fluid. Fluctuations in this cascade of light alone are wanting faithfully to represent the rapid succession of flashes of sheet lightning.

During common thunderstorms, sheet lightning is produced in the same manner as above; the two electricities combine in the higher rarefied regions of the air, without the explosion of electric volumes taking place. If a cloud be negatively electrified, sheet lightning will be produced behind the cloud; and hence it arises, no doubt, that the edges only of the clouds appear illuminated. If the cloud be positively electrified, the sheet lightning will naturally flash downward, the positive electricity uniting with the ascending negative electricity in its free yet accumulated state.

Of volcanic thunderstorms, Von Humboldt says: "The hot steam (from the waters that may have found their way into the interior of the mountain) rising during the eruption

from the crater, and emerging into the atmosphere, will, when cooling, form a cloud, by which the column of ashes and fire, many thousand feet high, is surrounded. Lightning, in winding motion, flashes from the column, and then the rolling thunder of the volcanic thunderstorm may be clearly distinguished from the cracking within the volcano. The lightning striking down from the volcanic steam cloud killed eleven horses and two men in Island on the 17th October, 1755."

The operation here is the same as before described; electricity from the higher regions concentrates in the volcanic cloud, whilst the volcanic column does not only carry up the electricity liberated within the volcano, but serves also as a conductor to that rising from the earth in the vicinity round about. At the eruption of Mount Vesuvius in April 1855, Professor Palmieri, at Naples, noticed that the electric current in general appeared to follow the course of the smoke issuing from the crater.

By a process similar to the preceding one, waterspouts are formed at sea.

In a "dead calm" the sun exercises, as a matter of course, a more powerful influence on the water than he does when it is in any way agitated. By the intensity and undisturbed accumulation of his rays on the quiescent surface, the air, resting upon it, becomes unusually rarefied; an extraordinary evaporation,—most likely assisted, if not chiefly caused, by volcanic action below,—takes place, as if the sea were steaming, and an immense quantity of negative electricity is produced or liberated. The electric fluid, tending to rise, but opposed by the resistance of the air, unites with the generated vapours as the only conductor it can lay hold of. The particles of vapour being heavier than the highly expanded air, are unable to ascend and form into a cloud;

attracted, therefore, and held together by the electricity they contain, and striving to rise, they all begin to move towards the centre, the focus of the foggy surface, until by degrees the whole mass is set in one uniform upward spiral motion, assuming the shape of a funnel turned upside down, and becoming more and more elevated as it becomes more contracted. The calm state of the air allows the quiet formation of the electric cone, which, in the absence of a conductor, like a wedge, parts and penetrates the impeding air, through which otherwise the body of diffused electrified vapours would not have been able to ascend, not having even the assistance of small things like grass and shrubs, which on land facilitate the escape of electricity from the earth into the air.

Currents will be produced where accumulation takes place, or the balance of fluids or liquids is disturbed. Fire expands water and air, and by disturbing their balance, currents are set in motion. Heat, whether from the rays of the sun, from fire or friction, disturbs the electric equilibrium of matter, and causes currents to take place.

Whilst thus the wedge is forming by a continual access of electricity and electric vapours, the surrounding air, likewise disturbed in its balance, begins by degrees to be slightly set in motion by the screw-like accumulation in the centre of the steaming surface; and this motion takes the same direction in which the wedge or screw is winding upwards. The air will thus gradually press more heavily on the base of the funnel, and less and less on the elevated part where it meets with less surface, and where the pressure is more on the incline; and by this means it even assists the progressive elevation of the negative spout.

The rising in a column, however, of this mass of electric vapours, would nevertheless not take place, if before, or at

the time of its formation into a spout, no cloud had been gathering in the sky, saturated with the positive electricity of the upper regions, exercising its attractive power on the negative accumulation below, and fixing, through it, as it were, a vertical axis. The two kindred elements tend to union, but have no conductor to effect it. Thus it is the attraction from above that makes the electric vapours, heavier and denser than the highly expanded air, and consequently unable to rise, assume the natural shape of a funnel-like wedge, whilst the attraction from below, in the absence of any conductor whatsoever, causes the same appearance in the cloud above: holding to a common axis, it is a kind of mutual magnetic suction, the spout above causing the one below, and the one below causing the other above, until, elongated within the striking-distance, within the point of amalgamation, they break down in union in the form of rain or hail, unable any longer to be held in suspense by the air which both cones contributed to set in spiral motion.

That previous to, or at the time of actual union of the spouts, no explosion takes place, may be accounted for in several ways.

Though, in the first instance, the extreme points of the cones may be seen, yet it is likely, and is even said to have been observed, that previous to their meeting, rays, or thread-like streams of electricity, are shooting forth from cone to cone; thus rendering visible the electric axis, the magnetic bridge, that had been thrown across at the commencement from kindred to kindred. These rays of electricity, however, concentrated by the tapering shape of the spout, as the rays of the sun are concentrated by a lens, must possess a correspondingly increased magnetic power, and may easily be supposed to act as a link, as a chain, and imponderable conductor, from cone to cone, by which both are steadily

and gradually drawn together. This electric link, the axis of the spout, as we have seen before, communicates between the cones soon after their formation, and sometimes before they come in contact. Hence, the amalgamation of the two fluids, harboured by these columns of vapour, and the union of the columns themselves, is so gradual, that no ignition, no explosion, can take place, there being very little, if any, friction with the air.

The absence of explosion may, in the second instance, be accounted for by the exceedingly saturated or condensed state of the vapours; they are too much like water to let the electric fluid have an easy escape, though this does not diminish their relative attraction, their tendency to unite being only somewhat fettered.

When the union of the two cones has been accomplished, and the two fluids have been brought to amalgamate, the whole mass, being now too condensed to be held any longer in suspense by the air, will violently burst or come down in rain or hail, and, according to circumstances, with or without lightning, accompanied with great noise, but without any thunder.

All these phenomena may easily be accounted for, particularly the bursting, the rain and hail; they depend upon the more or less rapid amalgamation or dissipation of the two electricities: if their union or dispersion is gentle and gradual, the spout will dissolve in rain; but if violent and sudden, positive electricity most likely preponderating, hail will be the result. Lightning will more or less depend upon the density of the respective cones, and their admixture with air during the amalgamation of the two electricities; and the lightning taking place within the spouts, and merely flashing out, as it is said, readily explains the rumbling noise;

but the electric fluid not passing or striking through the exterior atmosphere, as is the case during thunderstorms, accounts sufficiently for the absence of thunder.

If the "dead calm" at sea extends to a great distance, several waterspouts may naturally happen at the same time, each one forming its own centre. Their motion on the water seems to depend upon the upper currents of the atmosphere, the positive cone drawing along the negative one. They will also move in the direction of a ship, or of a prominent point on land, as centres of attraction and conductors to the electricity of the surrounding place.

Waterspouts on land happen from the same causes as those at sea, from the high position of positively electrified clouds, from isolated powerful conductors of the negative electricity of the earth, or from the absence of conductors.

Sandspouts in the desert originate in the same way as those at sea and on land. Electricity disengaged by the burning sun, by evaporation accumulated on the heated waste, and attracted either by electric clouds or other electric accumulations in the upper air, tries to rise; but having no conductor, it concentrates in one or more places, according to local causes, and the element pressing from all sides upon the centre, it assumes that spiral motion (around its own electric axis), which is witnessed throughout all nature, in the water, the air, and in the plant that winds itself round the protecting pole or the stem of a tree; and as the centre of the spout turns and rises and puts the air in motion, it gathers strength and consistency from the pressure around, taking up the sand within its powerful grasp; and like the avalanche in its fall, accumulating in bulk, electric force, and rapidity as it whirls round over the plane, it will often, like the water and landspout, change into a hurricane, tearing

up everything in its way, until its career is broken and impeded by internal exhaustion and dissolution, or by exterior obstacles and a dissipation of its electric accumulation. The aurora borealis, in the same manner, is an originator of storms.

Spouts originated only by the heat of the sun will scarcely ever, if at all, happen during the night, unless through some exceptional state of the atmosphere; and their formation during the day is no doubt intimately connected with submarine geological formations and dispositions, with the greater or lesser depth of the sea, the absence of currents, &c. The same causes most likely produce also local marine fogs and clouds which in bright weather have been observed on the high sea.

We have hitherto seen how electricity rises from the earth in streams or volumes, whether by the aid of conductors, or ascending with the cone of the spout; we have seen how by these means the electricity of the earth and that of the higher region are brought into union; but we have seen also at page 24 how the electric stream often rises beyond the region of the clouds, beyond the region where negative and positive electricity are wont to unite. And these streams, ascending higher than our ordinary conceptions, are by far more numerous than those which bring us the refreshing water and the cooling influence of the thunder-cloud. For, thunderstorms are comparatively rare in proportion to the electric volumes rising every day from the earth into the atmosphere.

These volumes perform their noiseless journey during the day, and in warm and cloudless nights; as the evening draws on, or the atmosphere cools; as a breeze springs up, or currents of air cross each other in sundry directions,—these pillars are cut off, some early, some late, some high, some

low, some in one state, some in another;\* and as they are cut off they contract, unless dissipated by wind, and form into spheres, small or large, according to circumstances. Arago found, according to Lardner, that when electric currents were transmitted through wires forming closed curves, or complete geometrical figures, iron filings, placed within the sphere of attraction of the wire, adhered to it, so as to form concentric rings upon it. The moment the connection of the wire with the piles was broken, and the current was no longer transmitted along it, the filings fell off, and all attraction disappeared. We may, therefore, well conclude, that these spheres, balls, or globes of electricity, attract metallic and other particles floating in the air, and that by the ignition and explosion of these electric metallic accumulations, fire-balls, meteors, shooting stars, and meteoric stones are produced.

That brimstone and other analogous solutions are contained in our atmosphere is evidenced by the many cases in which the lightning-flash, and thunderstorms themselves, have been accompanied by a suffocating sulphurous smell. Hence, the first thing of a meteoric character we meet with is the appearance of ball-lightning.

Whilst the electric columns, flashing into lightning, uncondensed, and in the act of ascending, had no opportunity, nor power, to attract much of the solutions filling the air, another volume cut off before coming into, or passing by, the striking distance of an electric opposite charge, had time to contract, to condense, and to form into a sphere; or, the rising volume still clinging to the earth, untouched by surrounding explosions, but resisted in its upward progress, its upper end began to accumulate into a ball. Thus, concentrated into an

\* Hence, also, the rarity of lightning striking into buildings, trees, &c. at night.

electric sphere of larger or smaller dimension, it more powerfully attracted the metallic substances within its reach, and coming within striking distance of another electric accumulation from below or from above, it shoots, a ball of fire, with lightning rapidity to the earth, whilst the ponderable particles that compose its bulk are less quickly dissolved or solidified; and by this means the globular form is preserved until its final explosion, diffusing in sulphurous smoke, and often spreading about in fragments, the evidence of ponderable matter diffused in the air.

This ponderable matter—which also is proved to fill the air, by the fact that metallic bases have been obtained in the analysis of plants whose nutriment has been derived exclusively from the atmosphere—will most likely be present at different times in different proportions; electric clouds will also attract it, and discharges therefrom will, therefore, often be attended by a peculiar smell; or, the matter in question will accumulate into a ball, or balls, according to the constitution and electric state of the cloud. These balls, concentrating within themselves a greater portion of electric and material accumulation, and coming within striking distance of volumes of electricity rising from the earth; or, repelled from each other and thrown off from the cloud, or sinking down by the weight of their agglomeration until friction with the air causes explosion, they will fall to the earth in the shape of balls of fire, according to the cause and circumstance of discharge from above.

That in most cases these ponderable electric balls are attracted from their position in the air or in the clouds by volumes of electricity rising from the earth is proved by the fact, that they mostly alight upon the steeples of churches or towers, and at sea, in particular, on the masts of ships.

These globes of fire, then, will be produced wherever

there is a sphere-like accumulation of one kind of electricity or the other, where, at the same time, ponderable and electric or magnetic substances fill the air; the light will ensue when friction with the air, or some chemical combination within the ball, causes ignition, and the explosion will take place when the intensity of action dissolves, melts, or solidifies, and repels or disperses the component parts. The combination of ponderable matter with the electric accumulation in these balls presents to us that spontaneous explosion and disappearance which we witness in the lightning-flash.

Ball-lightning of the kind we have spoken of is rare, because, happening at the time of thunderstorms, there is opportunity enough for the discharge and amalgamation of electricity in the shape of common lightning. But in calm, serene weather, the electric emanations and volumes will rise higher than the region of the clouds. Cut off from the earth by one means or the other, they will form into larger spheres than the balls before noticed; these spheres, assisted by the quiescent state of the atmosphere, will attract more ponderable matter, and, free from the condensed moisture which saturated the fire-ball before its ignition, and removed from the attraction of electric volumes or clouds, they will float longer in the air, until their final consummation. The electric sphere, like a shell, incloses the particles it has attracted, and by interior chemical excitation, or by friction with the air, ignites like a will-o'-the-wisp, and the agglomerated atoms amalgamate with great intensity. Impelled by its own weight, or attracted again from below, and pressed upon by the surrounding air in proportion to its velocity; having also by its presence and heat caused an accumulation of free, positive electricity,—the explosion envelops the electric shell and solidifies the agglomerated mass within, and, impressing upon its surface a deep black coating as a mark of the

violence of its action and evidence of its warm embrace, sends down to the earth the product of electric combustion and amalgamation—the meteoric stone. If more than one stone fall from the exploding meteor, it is clear that in this case the ponderable accumulation was not confined to, or concentrated in, the shell, the outer envelope of the ball, but that it penetrated the whole electric sphere, which, flashing into fire from within, or across, separated the body by repulsion, and dispersed it into numbers of fragments by its explosion.

That these meteoric stones are formed within our atmosphere is beyond contradiction; for, the sulphurous smell accompanies the lightning-flash, proceeds from the lightning-ball, that, itself issuing from the clouds, fell on the masthead and the steeple, into the church and the house, and often scattering about fragments; clouds are formed and meteoric stones projected from them to the earth; balls of fire, and brilliant globes of light often shower them down, and even the shooting stars have let them drop.\* And where there is such an undefinable transition, both in appearance and

\* Instances to prove all these cases are not wanting, and any work on meteorology or natural science may be referred to in order to find them. An awful proof, recorded in Holy Scriptures (Genesis xix. 24), tells us, “that the Lord rained brimstone and fire upon Sodom and Gomorrha, and destroyed these cities, and all the country about, all the inhabitants of the cities, and all things that spring from the earth.” And how naturally can we not account for such a phenomenon? But, to the Christian philosopher, it is far more congenial, consoling, and encouraging still to contemplate in this event the truth and confirmation of divine revelation; how the laws of grace and justice govern the laws of nature; how hand in hand they go, and in due time, and at the proper place, not only punish the guilty creature, and purge the earth from rotten generations, but also how therein he possesses the guarantee that the same laws of grace and nature will go hand in hand to raise him to transcendent bliss, as they have done in the saints even here on earth.

result, from the lightning-flash to the shooting star, from the will-o'-the-wisp to the most brilliant meteor: who will point out the line of demarcation, the broken link, and say, the one phenomenon is of the earth (telluric origin), the other comes from beyond it (cosmic origin)?

Not only this: but the metallic, or earthy composition of meteoric stones contains nothing that is foreign to what the crust of the earth is composed of; and the violence of electric action accounts sufficiently for the solidity, as the magnetic properties of the attracted particles do for the purity of meteoric metals.

That nothing so pure and solidly blended together is found in the earth seems to prove, that a less intense, a more gentle operation of electric agency was at work when chaos was sundered and the earth formed, than when fireballs or meteoric globes issue from the still existing, though purer, chaos of the air, or from the chaotic ingredients of the clouds in which they were moulded.

When, according to the state of the atmosphere, electric volumes from the earth, or spherical accumulations of electricity rise higher still than those which ordinarily produce meteoric stones, their dimensions must naturally increase with the altitude they attain, and with the rarefied air or matter within which they ascend; the same as in the case of balloons, which must be larger and more expanded in proportion to the elevation they are to reach. Hence it follows, that the higher the meteor, the greater its size; the further away from the sun, the larger or lighter the planets; the higher a bird is to soar, the wider must be its wings and the lighter its body.

Thus constituted, and no doubt frequently, if not always, more or less charged with phosphoric emanations from the earth, meteoric accumulations rise beyond our atmo-

sphere of air beyond the region which holds metals in solution, or though in a decreasing ratio only; and as they ascend and increase in size and aggregation of matter, interior distribution of particles, or of electric agency, will often, in the higher regions perhaps always, cause a mutual repulsion before explosion; the original sphere will part, as it were, into numbers of globes, which, after a longer or shorter course becoming ignited, present to us a host of shooting stars, emanating from one common point of radiation in apparently one or the other constellation of the heavens. Numbers of these meteoric globes rising from the earth, or forming in the atmosphere, and resistance to their motion diminishing as their elevation increases, their glow, ignition, and final explosion become more steady and protracted; their brilliancy augments as more and more they withdraw from the ocean of air into that of oxygen, the supporter of combustion, and thence into the still higher ocean of hydrogen, combustible itself. Thus they begin and pursue their brief but dazzling career, and separating into fragments, like the exploding rocket, scattering about the drops of light it inclosed, will give us those swarms of shooting stars, which, at certain periods of the year in particular, dart through the heavens, mainly in one direction. Less composed of ponderable substances, but more of gaseous matter, and acted upon by the currents in which they float, and the velocity or ease with which they themselves proceed, they often present an undulating course, and leave behind them streams or tails of glowing vapours.

According to the distance of meteors and shooting stars from the earth, the direction of their passage will be influenced by the currents above, and become more and more uniform the higher we ascend. The difference of temperature between the poles and the equator causes at all times

currents of water and of air and of moisture between them; and these currents within our atmosphere of air are often disturbed, crossed, and altered by local and other causes. These causes of altering currents do not, however, exist beyond our ocean of air, and the oceans above it partake only of the general movement from east to west.

Within these superior oceans, however, positive electricity, kept off from the earth by the nonconducting air, is at home and accumulates on the confines of our atmosphere, watching, so to say, every opportunity to come down and unite with the negative electricity below. This union is greatest and most intense at the equator; and though we are not as yet acquainted with the law of electric compensation, whether planetary, solar, or universal, we are certain that the greatest accumulation of terrestrial and atmospheric electricity exists at the poles. If, therefore, the evaporation of negative electricity at the equator is maintained by an uninterrupted current from the interior of the polar regions, the positive electricity of the air at the equator, spent in union with the former, is supplied by currents flowing above our atmosphere of air from the poles to the equator, uninfluenced by the configuration of the land and its interior organization, contrary to the opposite element.

When these currents, *en rapport* with the earth, in annual ebb and flow pass and repass from the poles to the equator, this *rappor*t touches or strikes a corresponding electric cord in the organization of the birds of passage, in harmony with which, exhilarated, they rise until they reach the respective altitude of the conductor, which awakened within them their slumbering instinct, and are safely guided by him into distant regions.

When in the same manner meteoric columns or accumulations rise to the requisite altitude, and by repulsion of

agglomerated particles disperse into numberless fragments; each separated fragment will again form its own sphere, and like birds of passage, as shooting stars follow the course, more or less, of these electric currents; and hence it arises, that all seem to move in the same or similar direction, and to follow the magnetic meridian of the earth, with a strong westerly deviation on account of the westward flow of the fluid matter above, caused by the eastward rotation of the earth itself. This latter circumstance will from hour to hour remove further away from the zenith the point of radiation of meteors, or shooting stars, ascended during the day or in the course of the evening, and make it appear as if the spot from which they seem to emanate were located, nay almost fixed, in the constellation in which first they were noticed. This, however, refers chiefly to those periodical swarms of shooting stars, which, more or less, last for several, even six to eight hours of the evening, the greatest number appearing generally about midnight.

The density and velocity of the aforesaid currents of positive electricity influencing the direction of shooting stars will naturally also affect their brilliancy, motion, and duration.

The link we have shown to exist between lightning and the highest and brightest globes of light is evident proof that these phenomena occur within the sphere of the earth, whatever distance the meteor may seem to be at, and that this sphere of ours is more than likely to embrace its faithful companion—the moon herself.

Before suns were kindled in the firmament of heaven, God may have willed it that, an electric accumulation, she rose up from the earth, and, as molten nickel poured into water will form little hollow globes, so, instead of fusing into a compact meteoric composition, or dispersing into numberless fragments, it may have blazed up under favourable combinations

without consolidation or division, and been converted into a cork-like ball; and preserving a semi-electric condition, she continued to float like a discharged vessel, less dense and heavy above than below, within the sphere that gave her birth, in order to reflect light on the body from which she proceeded.

The planets themselves, in a similar manner, in meteoric progression, may have risen from the suns round whom they revolve, when these primaries, by the Word of God, had been distributed throughout the creation, each one forming strata after strata of attracted matter around their own electric accumulation by feeding upon the surrounding chaos, and thus preserving their floating, and ultimately revolving capacities. This, indeed, seems to me more likely, than that, in the words of Sir David Brewster, "thirty asteroids,\* relics of a once mighty planet, are revolving in dissevered orbits, and warning the vain astronomer of another world that a similar fate may await his own." That a planet should be shattered in pieces, and its thirty or more solid fragments, by some abstract magic power, assume the form of globes; that these fragments should become centres, and accommodate themselves to the reputed law of universal gravitation, keeping each other apart, and yet not beyond a certain respectful distance, and that, irrespective of the impulse they received, when torn asunder, in the direction of every quarter of the universe, they should continue to revolve in the same plane and in the same orbital space in which their formerly common body is said to have been whirled by the hand of the Almighty, is to me too much to comprehend.

The number, time, and periodicity of meteors and shooting

\* Since this was written by Sir David Brewster, 17 more asteroids have been discovered, so that there are now 47 in all.

stars will depend upon general as well as local expansion of the air by the heat of the sun, upon the thaws and frosts of the Arctic regions, upon the tranquil, dry, or moist state of the atmosphere, and of the superior oceans, upon local warmth of the land or the sea, upon the evaporation of electricity from volcanoes, and upon the electric currents from the poles to the equator.

Which of these circumstances may combine, or in what manner they may be favourable or unfavourable to meteoric phenomena, I have not had the time or facilities to examine; but as regards the general temperature of the air, the increase of heat, facilitating the escape of electricity from the earth, seems to bring with it an increase in the number of shooting stars. For, according to observations made at Paris, and generally in the north of Europe, the mean number of shooting stars during the first six months of the year is only three to four per hour, whilst during the last six months it rises as high as six to eight per hour, and with the departure of the sun to the south decreases again to the minima.

The two maxima occur in August and November, the one when the heat of summer is greatest and thunderstorms on the wane, the second when a moist state of the atmosphere steps in between the rains and dryness of summer and the snows and cold of winter, and when the electric currents of the upper regions begin again to flow more strongly to supply the consumption at the equator, which in our summer chiefly, if not exclusively, is supplied from the south.

Whether meteoric phenomena emanate in greater number from the sea or the land, is a question to be settled by observation, though I think that but very few have their origin on the sea; for, the same reason which prevents thunder and lightning from want of conductors, prevents also the rising of electric streams, and their subsequent

formation into spheres. One instance where such a sphere was formed on the water, confirmatory of what I have said, is recorded in the "Philosophical Transactions:" "It happened on board the *Montague*, on the 4th of November, 1748, in latitude  $42^{\circ} 48'$ , and  $9^{\circ} 3'$  west longitude; about noon. One of the quartermasters desired the master of the vessel to look to the windward, when he observed a large ball of blue fire rolling apparently on the surface of the water, at the distance of three miles from them. It rose almost perpendicular, when it was within forty or fifty yards from the main chains of the ship; it then went off with an explosion, as if a hundred canons had been fired at one time, and left so strong a smell of sulphur, that the ship seemed to contain nothing else. After the noise had subsided, the maintopmast was found shattered to pieces, and the mast itself was rent quite down to the keel. Five men were knocked down, and one of them greatly burnt by the explosion." The ball was said to have been as big as a millstone.

It will also be a matter of observation, whether shooting stars diminish when the aurora borealis is prevalent; whether meteors will be scarce when and where thunderstorms are frequent; whether meteors and meteoric stones fall about the time of volcanic eruptions; and whether meteoric phenomena are most frequent and numerous in the tropics.

When in the higher latitudes these meteoric emanations from the land or the sea are arrested by the cold state of the atmosphere, by clouds of frozen vapours or snow, they will give us that most magnificent of all phenomena, the—

### AURORA BOREALIS.

The accumulation of electricity, like the density of the air and of oxygen, is greatest at the poles, owing to the intense cold, the rarefaction of the upper regions of the

atmosphere, and the snow and ice which cover land and sea, and which form a barrier to the escape of negative electricity from the earth. The accumulation, also, is greater at the north than at the south pole, the former having more land, and the latter more water, and the one holding more electricity than the other. The evidence of this accumulation, of these reservoirs of electricity, lies in their attraction of the magnetic needle; for, the greater the quantity of electricity, the greater the amount and force of magnetic power; and the greatest magnetic attraction is that of the north pole.

According to all accounts, the aurora borealis takes place after a thaw, though volcanic action on land and on water, as it produces clouds and thunderstorms, may also be one, if not a chief cause of its production. By this means, and in proportion to the rapidity of the thaw, an immense quantity of negative electricity confined in the earth, and accumulated on its surface under the cover of snow and ice, is liberated; and trying to rise through the air which opposes its passage, it creeps up at the sides of hills and mountains, which abound in the Arctic regions, and ascends also with the rising vapours.

Electricity is the binding and dissolving element of bodies, the same as fire and water, which decompose some and solidify others; electricity gathers the vapours of the air and concentrates them into clouds, whilst within them it accumulates, and by its repulsive or expansive property prevents their aggregation into water; but no sooner has the cloud commenced to discharge its electric accumulation, than the same operation which decomposes water into hydrogen and oxygen, and reduces these gases again into water, begins to liquefy the aqueous vapours into drops of water to fall down on the land from which electricity arose to attract and collect it. If a cloud rises very high, and in its elevated position is unable

to discharge its electric accumulation by communication with electric accumulations from the earth, the positive element will more and more augment and concentrate within the cloud, until overcharged, it suddenly contracts and violently combines with the vapours, at the same time breaking them up into numberless bodies, to precipitate or send them down to the earth in the form of hail, or, as in regularly cold seasons, and with a more gradual operation of positive electricity, in flakes of snow. At night, when the atmosphere is cooled down and less expanded, clouds cannot attain the altitude which they rise to during the day; they, therefore, are not liable to be quickly transferred to a higher and colder stratum, to be there exposed to an increased accumulation of positive electricity and a sudden contraction; and hence the scarcity of hail at night.

It has been observed by Humboldt, that in fogs, and at the beginning of the fall of snow, in the plain as well as between 10 and 14,000 feet above the level of the sea, in cold as well as in tropical regions, the atmosphere quickly and frequently changes from one electrical state to the other; and this change, in the case of the clouds, seems, beyond question, to be in connection with, if not the main cause of, the formation of hail.

Wherever contraction is concerned, positive electricity seems mainly the operating agent. In winter, when all is cold, when the normal state of the atmosphere is to the highest degree positively electric, when snow and ice cover land and water, when negative electricity has retired from the vegetable creation into the bosom of the earth, all nature seems contracted. When metals are cold, retaining even the skin of the warm hand that touches them: is it, that warmth, that negative electricity, has been driven out of them, and positive electricity taken its place? Or is it that metals are

chemically combined with the positive element? that in metals, perhaps, we find positive, or, as may be, negative electricity in its most compressed state? that positive electricity not only explodes meteoric accumulations, but enters into combination with the metallic solutions of our atmosphere to produce meteoric stones? That, as fire and light, an evolution of electricity on a small scale, warm and kindle by induction, and contact, and chemical decomposition, solidify and liquefy bodies: electricity chemically combined with metals, and, effecting the same on a larger scale, is freed and decomposed again by electric batteries? As water is a compound of oxygen and hydrogen, and absorbs air containing oxygen: are metals, as they seem to me, a compound of some element or elements with electricity, which they absorb still by contact with electrified metals or magnets? If my theory be true, it will be an interesting subject for inquiry, what relation there is between magnetization and the specific gravity or density of metals, as also, whether iron could not be saturated with some substance or other to prevent its magnetization in shipping, &c.? Whether acids are not minutely condensed particles of electricity, a condensation of electric matter?

These and other questions naturally present themselves to the mind, and seem to me to be objects of the highest importance, though for the moment they lead away from the subject.

When water begins to congeal and to freeze: is it not likely that warmth, that negative electricity gives way to positive, the same as no doubt it does in the change from rain to hail and snow? that, having been contracted and taken possession of, the newly-formed ice will expand again by a continued and passive accession of the positive fluid, by nature expansive? That by these means ice will become lighter and float upon the water from which it had been

formed? That ice and snow melted by the rays of the sun will dissolve into vapours, of themselves highly electric, and thus all the more be calculated to assist and promote the formation and development of the aurora borealis?

Whether vapours thus disengaged will lose or change their electric condition, whether they will be transferred into fogs, into clouds of rain, or again into snow or icy particles, will depend on the temperature and the electric condition and currents of the superior air; and this, no doubt, will determine the way, form, colour, and duration of the phenomenon in the amalgamation of the two electric fluids near the poles.

From the nature of the aurora borealis, the *cold* state of the upper atmosphere, and the general rapidity of the thaw, it seems to me likely that the electricity of the earth rises, both by the conduction of mountains and vapours, generally without any of the electricity above coming down any distance into our atmosphere, or settling in clouds, as it does in thunderstorms and waterspouts. Hence, no condensed body, or charges of positive electricity, will in this case be formed, and the fluid remains free and passive, as it were, though accumulating by the attraction from below; and as by electric discharges in the rarefied air of a *partially* exhausted receiver, the glow, which, according to Faraday, precedes the brush and actual explosion, is readily obtained, so the negative streams, or negative clouds of vapour, coming up and in contact with the former, the silent lightning, the sheet-lightnings of our summer evenings, will take place, as also has been shown before: but by the presence, or vicinity of the ocean of oxygen which I believe to exist above our atmosphere of air, by the composition of the air itself, as well as by other conditions, this silent lightning, this glow, will be changed into the Northern Light as it most commonly appears.

The shape of the earth, the ring of vapours or clouds that gird the Polar regions, the atmosphere floating like an arch on the globe, may account for the curve or arch in which the aurora borealis presents itself to our view; but it seems to me more probable, that electric columns rising up at extreme points of the plane or place of evaporation, without any, at least lofty, volumes rising up in the centre or intermediate parts, at these points draw down the positive fluid nearer to the earth than it can descend in the middle; and hence the appearance of a vaulted firework.

One of the experiments of Sir H. Davy proves that electric accumulations and currents are influenced by magnets. It is, therefore, quite evident, that the electric volumes rising from the earth have power to draw down and to draw out of their course and altitude the currents and accumulations of the positive electricity above. "He placed" (quoting from Dr. Lardner) "two pieces of charcoal in connection with the wires of a powerful voltaic battery, and, by presenting their points towards each other, at a distance varying from one to four inches, according to the density of the air in which the experiment was made, he obtained a column of electric fluid formed by the current passing through the space between the charcoal points. This current was not transmitted, as usual, along any conductor, but merely passed through the air between the points, and its presence was rendered manifest by the light evolved. When a powerful magnet was presented to this column, with its pole at a very acute angle to it, the current was attracted or repelled with a rotatory motion, or made to revolve by placing the poles in different positions, in the same manner as metallic wire conducting the current would have been. The electric column was more easily affected by the magnet, and its motion was more rapid when it passed through dense than through

rarefied air; and, in this case, the conducting medium, or chain of aëriform particles, was much shorter."

The same influence which in this instance was exercised by the magnet upon the electric current between the two pieces of charcoal, is, in the case of the aurora borealis, exercised by the electric volumes rising from the earth in certain places and at certain times upon the currents of the superior regions, to which their points or poles form more or less acute angles.

Mr. Biot, according to Dr. Lardner, "conceives that the luminous columns composing the aurora have not in reality the position or form which they appear to the eye to have; but that their apparent form is merely the result of perspective. He considers, and truly so, that the phenomenon is produced by an infinite number of luminous columns, parallel to the dipping-needle and to each other, arranged side by side at nearly the same height from the surface of the earth; these systems of columns being placed at unequal distances from the eye, and seen under different angles of obliquity, are projected into various figures, which are subject to variation arising from the varying splendour of their component rays." Add to this, that clouds of some sort or other will also form in the upper regions, or be carried thither by atmospheric currents, charged perhaps with ponderable matter, and collecting and accumulating the positive electricity of the higher sphere; that these clouds will, dispersed or united, correspond in position to the negative columns or clouds rising from the earth, as in the case of waterspouts cone corresponds to cone; and that for want of conductors, where trees, hills, and mountains are scarce, clouds at the formation of the aurora borealis will always assume the conical figure of the waterspout; that there may be a discharge of electricity between two clouds, one above

the other; that, itself a dark segment, an electric cloud may send up lofty cones into the upper regions, and communicate also with the space below, as sometimes is the case with thunderclouds; that meteoric, globular accumulations from the earth may be attracted and concentrated over a certain area by a cloud or clouds, or their ascent impeded by too cold a state of the upper strata of air, and thus ignite and break out into streams of light; that above all there is a constant overflowing of positive electricity at the poles, and returning in regular currents high above us to the equator; that these currents alone are sufficient to account for all the electric accumulations of the higher regions, that, in fact, the aurora borealis will form itself into all shapes, if over against numerous ascending columns of negative electricity, positive volumes or accumulations arrange themselves from the beforementioned causes: and it may easily be imagined that the amalgamation of the two electricities under various atmospheric densities and conditions will produce all those splendid displays of the phenomena which so often have dazzled and charmed the beholder.

Brilliancy and colour depend upon the proportionate presence of atmospheric air, of oxygen, on the state and composition of clouds and vapours, and particularly on the refraction and reflection of light in the Arctic regions; the direction and motion of the aurora borealis will be influenced by the electric fluid from the earth, currents of the atmosphere, and the rotation of the earth itself; but there can be no doubt that it is itself nothing but the amalgamation of the two electricities, in a different clime, under different circumstances, and for a different end. Almost all philosophers of natural science are agreed, that the aurora borealis is the result of electric agency; but, according to Dr. Lardner, Eberhart, Professor of Halle, and Paul Frisi at

Pisa, were the first who proposed the explanation of the phenomenon being the effect of atmospheric electricities, founded on the following facts:—

“1. Electricity transmitted through rarefied air exhibits a luminous appearance, precisely similar to that of the aurora borealis.”

“2. The strata of atmospheric air become rarefied as their altitude above the surface of the earth is increased.” Hence they argued, in the words of the doctor, that the aurora is nothing more than electric discharges transmitted through parts of the upper regions of the atmosphere, so rarefied as to produce that peculiar luminous appearance which they exhibit.”

Whether the aurora borealis is more frequent and intense in severe or mild winters, whether it is chiefly local, and happens about the time of electric high tide, of which latter I shall treat hereafter, I have not been able to enter into and to ascertain.

The phenomenon must necessarily exercise a very sensible effect upon the magnetic needle, owing to the immense quantity of electricity liberated and brought into action from a state of rest, by the time it has reached its height, or the point of culmination; and the disturbance in the previous magnetic state of the atmosphere must obviously be greater or less, according to the intensity of the electric evaporation and consummation.

The amalgamation of the two electricities, as in the case of waterspouts, is not necessarily accompanied with thunder, though the development of the aurora borealis, by a few, is said also to be at times attended with a crackling noise; and this may be accounted for by the electric sparks coming, on these occasions, from a more or less compact segment of the aurora, more or less in contact with the denser, and to us nearer, part of the atmosphere.

When the phenomenon takes place on the confines of our atmosphere of air, it is too distant, and the air too rarefied to produce or transmit to us any sound ; for, sound is best produced and propagated where the air is densest, and where the bodies or substances causing the sound, and giving character to it, are those which are the most solid. Hence, in the case of thunderstorms even, thunder will always be loud in proportion to the density of the cloud, and weak in proportion to its attenuity. Humboldt has proved also, that sounds are audible at greater distances by night than by day ; and this arises from the greater density of the air at night to what it is by day.

Sound, the most charming and soul-stirring of all the wonders of a bountiful Creator, is the effect of a more or less violent friction of the air with more solid bodies ; it is an agitation of the air striking against more opaque bodies than itself, modified by the substance with which the friction takes place, or by which the agitation is produced ; and the agitation itself is caused by a displacement or by a disturbance of the equilibrium of the air in one way or another.

When, originated by the pressure of the moon or the cloud, or by the electric phenomena of land, sand and waterspouts, the tempest roars over the sea, sweeps through the forest, assails the lofty castle, and whistles and howls about our dwellings : there is a violent friction of the air, and its sound tells us of the awful power with which God invested the element of our life. When the hammer strikes upon the bell, when lightning flashes, when the waves of the sea run up against the shore, there is a violent displacement and consequent agitation of the air ; when the organ swells, the trumpet sounds, and music of every kind steals upon the ear, it comes from a more gentle, but still the same friction, displacement and agitation of the air, and fills us with

delight ; we have it in the song of the mother, and in the laugh of the child ; in the discourse of the man and the merriment of the boy ; and these human voices are the tones that are sweetest and touch us most, and above all, when coming from those whom we love ; but all is friction, displacement, and agitation of the air wherever utterance was given to animated creation to proclaim the glory of God. And in all these cases the volume, power, and weakness of sound is proportioned to the force of friction or agitation, its character established by the substance acted upon and producing agitation, and its scale determined by a concentration or extension of space of displacement, a concentration or extension of agitation or vibration.

The propagation of this agitation, of sound, depends upon the bodies in connection, in contact with, or contiguous to the spot or place where the displacement of the air originated. If these bodies are smooth or polished, sound may be conveyed to an extraordinary distance ; if they are rough and uneven, or porous, it will travel but little and lose its intensity ; and this for the following reasons :—

If a stone be thrown into the water, rings will propagate all over the surface until the original force is spent, the rings die away, are intercepted, or broken at the shore ; ordinarily there is nothing to impede the extension of the circle of the wave on the surface of the water. But as the stone is sinking to the bottom, the rings around it will soon have ceased ; everywhere surrounded and pressed upon by the water, the displacing force of the stone neutralized and destroyed, and from all sides rushing in upon the space it has passed through as it goes down, no ring can form, much less propagate, after the first moment of immersion.

It is the same with sound produced in the air. Surrounded by air, it diffuses in every direction like the rays of light ; and the air also rushing from all sides upon the spot where

displacement and agitation began, prevents its propagation to any particular extent. But wherever the air presents any surface, and according to the nature of this surface, sound travels to a much greater distance.

This surface of the air exists wherever it leans against a solid, liquid, or condensed fluid body ; resting upon the river, the lake or the sea, the lower surface of the air reposes on the surface of the water ; on land, the lower surface of the air rests on rough and broken ground ; there is a surface of the air pressing against every body in nature capable of pressure ; there is a surface of the air on the slab of the table and underneath it ; there is one against the wall, the floor, and the ceiling ; in fact, against every tangible object.

If these surfaces of the air lean against surfaces of bodies polished or uninterruptedly even, sound will travel the longest distance, because the wave originally created is propagated without impediment until it naturally dies away ; but if the surface of bodies is rough, loose, or porous, the wave of the air passing over it is everywhere and every moment impeded, broken, or absorbed, and consequently soon exhausted or destroyed. Hence it follows, that sound is conveyed by the air only, according to the surface which receives the first undulation, and that it is sustained by the length of time required to bring the agitated air into a state of rest : and this will last longer on smooth and rounded surfaces than on rough and uneven or cornered bodies, as it will also depend on the oscillation and swinging of bodies, by or on which the friction of the air, the sound has been produced, until they likewise come to a state of rest.

When cannons are fired at sea, it is not the water that conveys the sound to an extraordinary distance, but the displacement and consequent wave of the air caused by the explosion, and propagated without impediment over the liquid

surface. If the water is agitated, its undulation will, as it were, give light and shade to the sound, and make it resemble the distant, scarcely audible, rolling of thunder. When the tramping of horses is heard at a greater distance by putting the ear close to the earth, than it is when heard within, or through, the body of the air: it is not the earth that conveys the sound, but the agitated surface of the air resting upon it. Hence also the fact, that apart from the greater density of the air, sound is propagated and heard to a greater distance in winter than at any other time, because snow covers the ground, and presents an extended and smoother surface to the air-wave passing over it, particularly when the snow is not soft, but more or less frozen over.

When in the whispering gallery of St. Paul's a person speaks across the dome, he will not be heard on the opposite side, because the sound produced, meeting everywhere with resistance, and weakened by diffusion, soon dies away in the air; but let him speak close to the wall, and the wave of sound created on the surface of the air leaning against it, will immediately pass round the whole circle, because there is nothing to hinder its propagation. It is not the wall, as is supposed, that conveys or deflects the sound, but the surface of the air resting against it.

If a poker be made to strike against a chair, table, or other body: it is not the poker through which the sound is conveyed to our ear, but by the waving air embracing its polished surface. If a beam of timber be struck, or scratched with a pin or nail at one end, and the sound comes to your ear at the other as passing through the wood itself: it is not the wood that vibrates or conveys that sound, but the wave produced by the scratch or stroke, and propagated on the surface of the air embracing the surface of the beam, and concentrated again in one focus at the opposite end.

If, as was done by Professor Wheatstone at the Polytechnic Institution, a piano or other musical instruments are placed in the cellar or souterrain of the house, and the instruments brought in communication with an upper apartment by means of staves carried through the several intervening ceilings, the music performed below will, as if present, be heard above. For this purpose the staves must be in connection with the sounding-boards of the instruments in the cellar as well as with the sounding-board of some musical instrument above.

In this case, however, it is not, as has been imagined, the wood, the staves, that convey ex- or in-teriorly the sound from below to the room upstairs, but the wave of the air passing along the staves. The staves, like all conducting bodies of sound, are entirely passive,—they are innocent of the transmission of harmony along their surface. Had the apertures by which the staves were carried from ceiling through ceiling been made to close air-tight upon them, no sound whatever would have passed. Had the sounding-boards of harps or other instruments above been removed, the sound from below would not have spread over the apartment, but only been able to be heard by listening at the extremity of the staves, from which it would escape into the free air of the room, and there be lost by speedy diffusion. Had the experiment been reversed, and the music performed upstairs instead of below, the sound would not so easily have been heard in the cellar, because the vertical descent of an air-wave, however free to move, is against the natural upward current of the atmosphere, itself the result of a constantly higher state of warmth of its lower strata.

When the bell sounds the merry peal, it is not the shaking or motion of every particle of the metal that causes and diffuses the sound, but the violent concussion of the hammer with the bell suddenly forcing the air from its place, and

driving the wave all over the bell into the open atmosphere, in proportion to the intensity of the stroke. If dust have accumulated on the bell, it will change place according to the wave of air which passed over the surface, but not on account of any motion of the atoms or particles composing the metal.\*

Professor Faraday, in his lecture on Friday, December 26th, 1856, according to the *Morning Chronicle*, says: "Observe the elasticity of a bell, which causes the sound to vibrate, and produces chimes, tolling, &c.; put the bell under a slow fire for two or three minutes, the sound is dull, the elasticity is gone; let it get cold, the sound returns to it."

But this is evidently wrong. If the sound grows dull when the bell is warmed, it is not owing to a diminished elasticity of the metal, but to the warmer state of the air coming in immediate contact with the bell, as it is a well-known fact, that sound propagates louder and farther in winter than in summer, in a cold than in a warm, in a dense

\* If light particles of dust be on the outside of a bell when it is struck, you will, by their motion, have no doubt but that the *particles of the metal move too*, though not sufficiently to be visible to the naked eye. If you take a plate of glass and sprinkle on it a little fine sand, and then hold it at one corner by a pair of pliers, and pass a violin bow along one of the sides, you will see the sand arrange itself into a uniform figure; if you apply the bow to one corner, the figure will be varied; and by these means you may produce some beautiful arrangements of the sand, and almost say that you *see* sound. (T. Joyce's "Scientific Dialogues.")

In these instances, as I have observed already, it is not the metal that moves (the italics above are my own), not the glass that vibrates, but the agitated air, the waves caused by the hammer and the bow, that cause the dust and the sand to arrange themselves into regular forms and figures on the body, over whose surface the waves are passing.

than in an expanded state of the air. Hence also the difficulty of the singer, and his vain exertion to produce a good tone in warm weather, in an expanded and attenuated state of the air. The warm air is thin and more elastic, consequently gives way, and offers, as it were, no volume or body to the striking hammer, receives, therefore, but a slight shock, and propagates but a feeble wave. The air, when cold, as a denser body, more resists the falling stroke, the displacement is more violent, more particles of air are acted upon, and the agitation or vibration becomes stronger, and the sound louder and longer, both as to time and distance; the density of the air is a multiplied propagator of the wave and agitation originally created, and sound will continue until the agitated air has subsided into rest, for which one substance or body, surface and form, is more calculated than the other.

It follows from all this, that sound can neither penetrate through solid bodies, which are impervious to the air itself, nor be conducted by any solid bodies, not in contact with the air. If gases, water, or other seemingly condensed or opaque bodies, convey sound without being in immediate contact with the atmosphere, it is because they are saturated with air, the air within them is concentrated, and they are, therefore, still in contact, however remotely, with the atmosphere. If there were no communication of the atmosphere with the air in the interior of a closed watch, you would not hear its ticking, the same as you do not hear a bell if placed under an exhausted receiver, unless you put your ear close to the smooth and solid body on which the receiver may rest; for the wave, however thin, will still affect the air outside along the polished surface of the said body, as the receiver may be very highly rarefied within, but can never entirely be exhausted. It is the same with a musical box put under the

receiver; if it rest on a solid substance, its sound will be heard; but if placed on a bag of wool, it will become inaudible, because the bag will absorb or break the wave.

One of the most beautiful evidences, how, from the recess of inclosure, the slightest motion given to the air is conveyed to the ear, is afforded by the stethoscope, which, on being applied to the human frame, naturally penetrated with air, reveals to us the sanitary state of the lungs and heart. Their expansion, and contraction, and pulsation, produce and convey, through mouth and nostrils exteriorly, an air-wave over the surface of the body, which wave, concentrated more or less around and within the instrument, breaks into the ear. Or, the heaving and beating of lungs and heart, by and through the skin, is communicated to the air within and without the stethoscope; and, however slight, an indent, a feeble wave or motion of the air is produced, which silently, in a whisper, in an echo, as it were, strikes the listening mind; the ear rather feels than hears the inward action.

Thus, there cannot possibly be any sound where there is no air, or where the friction or concussion of solid bodies, or the vibration of any substance is not communicated to it in some way or other. Sound, therefore, though it may have many fathers, knows no other mother and conductor but the air.

And yet I am inclined to think, that there is something more concerned in the production of sound than the mere friction or concussion with the air. The great rapidity of the conveyance of sound in comparison to the motion of the air itself, to the fleetest of hurricanes; the propagation of sound through and against the strongest wind, which, one should think, would overcome, or at least neutralize, any air-wave, any vibration of the air caused by whatever means, whilst the mere use of the human voice will penetrate through

the opposing storm; the sound which will reach the ear from within the—although never entirely—exhausted receiver, notwithstanding the apparently broken connection with the air outside; the increase of sound within and from the exhausted receiver if a few drops of alcohol or ether, which quickly evaporate, are put in; the divergence of musical harmonies through the air in every direction, without the waves that convey them ever commingling together, but bringing each individual note or sound distinctly and at the same time to our ear; the fact of hard and solid substances, particularly metals, producing the loudest tone and propagating it farthest; that friction produces both sound and light: all this makes me suppose that the essence of sound is connected with electricity; that by whatever friction with the air, perhaps with its most important and mysterious ingredient, oxygen, a certain corresponding amount of electric excitation is produced; that this electric excitation is inseparably bound up with the air; that the air is the vehicle to bring the effects of this excitation in all their unimaginable variety to our mind; and as the sun sends forth his seven-coloured rays, shows them to us in the rainbow, and again in their most wonderful and infinite variety of mixture and union in every created object and in the works of man, so the same electric element, in indissoluble alliance with the air we breathe, sends, like rays of light, in another form, to our mind and heart the seven notes of the musical scale, with all that harmony which the genius of the composer has been and will still be able to weave out by their unlimited combination in inexhaustible measure, melody, and modulation.

The air, then, remains the mother, handmaid, and conductor of sound; it is the plastic element that yields to and adopts every impression, which it receives as a unit and subdivides into millions of undivided parts, conveying to each

hearer the unit unimpaired ; for, all will hear alike, all will taste alike, their hearts and minds will be filled with the unit, and yet they cannot contain or grasp it.

Conveying every kind of impression the air receives, undulated sounds, like the rolling of distant thunder, will fall upon our ear if a waggon rolls over the pavement, which being undulated, imparts its character and nature to the wave, the sound produced.

Thunder itself is produced in a similar manner.

Dr. Lardner states, that from "the reports of military engineers, who, being placed at elevated stations on the Pyrenees, and thus enabled to observe the superior surface of strata of clouds situated below them, it appears that there is no correspondence between the state of the lower and upper surface of a stratum of thunderclouds ; that when the inferior surface is perfectly even and level, the superior surface will be broken into ridges and protuberances, rising upwards to great altitudes, like the surface of the earth in an alpine district. In times of great heat, such strata were observed to send upwards lofty vertical cones, which, stretching into higher regions of the air, established, by their conducting power (no doubt themselves attracted by superior accumulations of free electricity), an electrical communication between strata of the atmosphere at very different heights. This appearance was generally observed to precede a thunder-storm."

Now when the lightning flashes from the cloud, the air is violently displaced, and the wave thereby created will pass with a uniformity of sound along the inferior level surface : but passing to the superior, undulated, surface of the cloud, the rolling thunder will be heard in proportion to the distance and intensity of the flash and the density of the cloud, and continue until the flux and reflux of air-wave or waves

re-subside into a state of rest. Even when near, an electric explosion behind the cloud only will give us but a faint murmur of the agitated air; but when the flash communicates with the earth, the vibration of the air will strike against more solid bodies, and the wave or waves above, often with repeated concussions, will propagate along the space through which the lightning passed; and hence the peal of thunder, at once so loud, long, and fluctuating. The violent displacement of the air may also set the cloud in a trembling, undulating motion at the inferior surface, thereby causing, or adding to, the rolling nature of the wave. The cloud is the sounding-board of the electric string; undulated and elastic, dense or light, high or low, near or far, it reverberates to us in awful majesty the power and greatness of the Creator, the same as, caused by the vibration of the string, the sounding-board of the musical instrument sends to us the exquisite harmonies, as it were, of heaven, to make us feel and appreciate the love and goodness of the Supreme Being in having made an element, more than any other in His especial service, to gratify our senses, elevate our thoughts, and dispose our minds to everything that is gentle and noble; for,—

“There is in souls a sympathy with sounds;  
And as the mind is pitch'd the ear is pleased  
With melting airs, or martial, brisk or grave:  
Some chord in unison with what we hear  
Is touch'd within us, and the heart replies.”—COWPER.

That clouds are capable of reflecting sound is proved by Muschenbroeck, who, according to Lardner, “states as the result of his own observations, that a cannon, which being discharged when the heavens were unclouded produced only a single report, had its sound several times reverberated when discharged in the same place under a clouded sky. In the course of experiments made in 1822 to determine the velocity

of sound already referred to, the same observation was made."

That clouds are often very dense, and press heavily upon the air, and consequently able to produce and verberate sound when the air is agitated on their surfaces, is proved by the smooth level which they present on the inferior surface, showing the weight with which they rest on the air, and by the strong winds which generally attend thunderstorms. The air, previously expanded by the heat of the sun, is rushed in upon by denser currents from other places, and the cloud floating in the atmosphere like a bridge, presses upon it with great power, and drives it away from underneath, whilst at the same time it forms an arch, through which the air will force itself with great impetuosity, as it does through the arch of a bridge; and the more bulky the bridge or the cloud, the more violent will be the rush.

Without clouds there will be no thunder: hence it is but a rumbling noise that sometimes attends the dissolution of the waterspout; yet at the time of earthquakes it seems sometimes to be heard in the air when the sky is perfectly clear. Though this is no case of common thunder, the noise, or apparent thunder, proceeds, nevertheless, from the upper regions of the atmosphere, and is no acoustic deception. Places at which this phenomenon happens to occur are subject to earthquakes, and possess volcanoes, either active or apparently burnt out. When violent concussions take place within them, the air which has sunk or settled down into the craters or fissures of the mountain is displaced and becomes agitated: the waves thus created travel up to the mouth or opening of the abyss, whence they propagate and diffuse in the superior regions of the atmosphere; and the vibration descending partially to the earth, apparent thunder will be heard by those who receive the impression of the agitated

air, according to the beautiful design by which the *Divine Intelligence* modelled the human ear, so that sound from before and behind, from above and below, the air-wave falling upon the organ of hearing, should convey and indicate to the brain and soul of man and other living creatures, the direction of its coming.

When by means of fissures or openings the air on the ground comes in contact with volcanic concussions in the interior of the earth, the noise appears to proceed from its very bowels, and the wave created will travel along the surface of the ground until it dies away or is broken, preserving all the time the subterranean character imparted to it by the original cause and material of agitation. The earth is the sounding-board of the vibration caused at certain places within, and there first communicated to the air by direct or indirect contact.

"I have minutely ascertained (says Humboldt), that the great shock of the earthquake of Riobamba (4th February, 1797), one of the most terrible phenomena of the physical history of our earth, was unaccompanied by any noise."

In this instance it is evident that the concussions, or actions, of the heaving material, or the electric current below, came not in contact with the air at the place of the earthquake, though it must have done so, direct or indirectly, at a great distance away from it, where, eighteen or twenty minutes *after* the actual catastrophe, a great subterranean noise was heard. From this it also follows, that shocks of earthquakes may happen without any apparent subterranean noise, and that subterranean noise may be heard without any shock being experienced.

Earthquakes and volcanoes, in a remarkable manner, seem to confirm my theory of electricity, not only on account of the thunderstorms which so frequently accompany earth-

quakes and volcanic eruptions, but also on account of all the other phenomena by which they are more or less attended.

That earthquakes and volcanic eruptions are the effect of electric disturbances is fully established by Professor Palmieri's recent observations.

On the occasion of the earthquakes of Mefi, he used the magnetic apparatus of Lamont, and the result led him to believe that it would no less act on the occasion of an eruption. He observed great changes in the electrical condition of the atmosphere; on the 29th April, 1855, the needles of the aforesaid apparatus had been slightly affected; they were greatly agitated on the 30th, so as to amount to what the professor calls a magnetic storm, and on the following day the eruption of Mount Vesuvius broke out. During the eruption the magnetic vibrations continued with increased intensity, and the electrical state of the atmosphere, quite in correspondence with my theory, was equally remarkable, being greater than the maximum in ordinary times; its diurnal period was disturbed, greater electricity having been observed during the night than during the day; and what was still more singular, during the eruption of ashes the fixed conductors gave but slight indication of negative electricity, while the movable ones gave the strongest possible signs of positive tension. In general the electric current appeared to follow the course of the smoke. A letter in the *Athenæum* of 2nd June, 1855, gives an interesting account of the eruption.

The electric fluid with which our earth, and every planet and sun has been inflated, or endowed, by Divine Wisdom, and which by the construction and enormous thickness of the crust of our globe, as well as by its atmosphere, is kept bound and imprisoned within its bowels, has a natural tendency to be freed, and to burst the vault that holds it confined,

and within which it dwells and circulates like the blood in the human body, with its heart, veins, and arteries, whilst, at the same time, it pervades the minutest parts of the whole frame ; and this tendency to break its bonds is further aided by the rays of the sun heating the surface of the earth and expanding the air, thus opening, as it were, a door for the escape of the fluid, and attracting it to the heated and expanded area from within all parts of the earth.

In this manner, to wherever the sun shines, to wherever the earth is warmed and its atmosphere expanded by the great luminary of our system, there will be an interior, uninterrupted, current of electricity. But this current is everywhere impeded by nonconducting masses, and thus, the bursting of electric veins and arteries, or the forcing of a passage, produce "horizontal oscillations of the surface of our earth, similar to the waves of an agitated sea, violent perpendicular up-liftings ; so that it would seem as if repeated explosions were exerting their force against the roof of a subterranean cavern, threatening to burst it open and to blow into the air everything placed over it."\* In fact, if our atmosphere, pressing with a weight of 15 lb. to the square inch upon the earth, were rarefied to a very high degree, or withdrawn from it, earthquakes would be much more frequent and violent, and the earth itself might be blown and shivered into atoms.

When electric currents, to our every-day knowledge, are capable of melting rods of iron in a moment, the electric currents circulating within the earth are capable of producing that heat of our globe which increases as deeper we descend into its bowels, as we come nearer to the heart of its electric organization ; the powerful spring that drives these currents from the heart of the earth through the masses

\* This description of the effects of earthquakes is the language of a writer who wanted but the key of the theory to which it corresponds.

of its body, operating upon its various ingredients, melting and refining its metallic constituents, and sending up fountains after fountains of healing water, cold and warm, all over the earth, explains the enormous pressure which throws up stones, molten lava, &c., from a volcano, with a force equal to from 300 to 400 atmospheres, though water decomposed, or steam generated within the mountain by the intensity of the electric current, may add to the force of electricity itself. My theory explains the connection of volcanic agency between various parts of the earth, the simultaneous shocks at places far asunder, as for instance at the earthquake of Lisbon, on the 1st of November, 1755, which was felt in Greenland, Africa, and even America; and it accounts for the fact, that generally either the first, or one of the first shocks, are the most violent, because the first strokes of the electric power open the passage through opposing strata of the earth.

Volcanoes are the safety-valves, the lungs, of our globe in labour; they are the conductors of the unfettered element within; and happy those places that possess them. Providence also has placed them where they are most needed, that is, chiefly in those parts of the earth that are exposed to the greatest heat of the sun, and therefore more calculated to attract the electric current within, and give to it the opportunity of liberation. Volcanoes moreover, by Divine Wisdom, seem mostly placed close to the sea, not only with the view of originally raising bulwarks to the waters of the earth, *and cause the land to be separated from the water*, but also, because, near the sea, particularly at the bottom of the ocean, the electric fluid has a thinner crust to burst through than it would have in the midst of continents. Hence electric up-heavings on land are diminished, and at sea not so dangerous to man, though at times ships are

engulfed in the chasms of the ocean caused by the sudden rise and fall of its bottom.

The elevation of mountain-chains is evidently due to regular currents of elastic, *i.e.* electric forces; for, the lines of direction which characterize each group have such relations to each other, and are so symmetrically arranged over the earth's surface, that they cannot but be the result of that electrical organization of the interior of the earth of which I have spoken. It was, no doubt, first called into extraordinary activity when the whole solid globe was still covered with water, when the earth—though darkness had been banished from the face of the deep by the creation of light, and the waters separated from the waters by a firmament of air—was still void and empty, God said: "Let the waters that are under the heavens be gathered together into one place, and let the dry land appear. And it was done." And thus the electric current within the earth fulfilled the word of its Creator, and, by its volcanic action undulated the earth, and systematically and symmetrically raised up mountains and mountain-chains as so many monuments of the power and wisdom of God. The separation of land from the water was the first violent catastrophe our earth experienced for the benefit of man, who hereafter was to inhabit it; and it is only by the operation of a pent-up force of electric matter that we can satisfactorily account for the disturbance of all the strata of the crust of the earth, and their tumbling one over the other in the most extraordinary and seemingly confused positions and directions, rendering firmer and more compact even that shell, which, with its horizontal layers, could not withstand the electric element, since that time more effectually confined, and provided with the volcanic safety-valve to limit its destructive effect on the earth.

Apart from this universal revolution in the crust of the

earth, other tremendous concussions have taken place, as they still from time to time do occur, confined to individual portions of the globe. The elevation of new, and the sinking of old islands in the ocean, are evidence of this subterranean working of electricity.

Dr. Lardner says: "When storms are breaking in the heavens, and sometimes long before their commencement, and when their approach has not yet been manifested by any appearances in the firmament, phenomena are observed, apparently sympathetic, proceeding from the deep recesses of the earth, and exhibited under various forms at its surface." And these phenomena proceeding from the deep recesses of the earth, as Dr. Lardner truly says, without, however, suspecting the true cause, most strikingly confirm the theory I have laid down: of an accumulation and organization of negative electricity within the earth.

This negative electricity, though separated by the non-conducting air from the positive electricity of the superior regions, is never totally severed from it; the thread, the link of union, however finely spun, however attenuately distended, is never altogether broken; like rarefied air, to what extent soever expanded, the active, though invisible and imperceptible, union with the distant accumulation of the most dense and cold atmosphere is never for one moment interrupted; the thread of India-rubber, drawn out to its utmost length and attenuity, its particles will still retain their hold upon one another, and resume their ordinary condition as soon as the distending power or cause is removed. The two electricities in the same way will hold each other, and approach in accumulation, or retire in expansion, according to the condition of the barrier or power that in the ordinary state keeps them in distant communion, and at other times allows them in force to amalgamate.

Thus, when storms are approaching, though unperceived in the heavens, the two electricities are gradually drawing into closer communion ; that from within the earth will force its way through certain wonted channels, causing fountains to boil, springs to flow, after having been dry for a time, and often heave up the waters of rivers and lakes and the sea, roll them in furious waves and drive them over their banks, rend hills in two, open their sides and bring with it the waters of the veins it has opened in the earth ; and at times even it will open awful pits and blast abysses in the bosom of the earth, and like gashing wounds force asunder and divide the waters of the mirror of the ocean.

From the day on which God separated the waters from the waters until Noah went into the ark, dews only had nourished and refreshed the vegetable creation ; no rain had as yet fallen\* upon the earth. Since the sun had broken out into light, hydrogen and oxygen gases receded to a still greater distance from the earth than before, and mists rose higher into the air ; but as yet all the pores of the earth were open, evaporation of water and electricity, and climate, was general and even all over its surface ; there were as yet no separate accumulations or concentrations of these elements in the atmosphere, and the vapours that had risen returned again as heavy dews ere they could ascend high enough to condense and fall down in drops of rain, or in the form of hail or snow.

When at last the solid body of the earth had increased in bulk and hardened so as to accumulate a greater amount of heat on its surface and correspondingly to expand the air :

\* There are still countries, such as Peru, and places, where it never rains, but where heavy dews supply the earth with moisture. For the last three years it never rained at the island Teneriffe, by which famine and disease were produced and multitudes obliged to leave the island. In Egypt it has not rained for 700 or 800 years.

God gathered the rising mist into one vast sheet, into a universal cloud enveloping the whole earth; electricity from above accumulated in the aggregated vapours (no doubt also peculiarly acted upon by the rays of the sun, which they received and absorbed), and whilst moulding them into drops, and moreover converting into water the oxygen and hydrogen gases that had followed its accumulation in the cloud, it drew forth from its stronghold, into closer embrace, the electricity within the bowels of the earth; and thus it came that "in the 600th year of Noah's life, in the second month, the seventeenth day of the month, the same day all the foundations of the great deep were broken up, and the windows of heaven were opened." Thus a law of nature harmonized with the moral law of God, the law of justice, and swept away a sinful world.

Unaccompanied with lightning and thunder, the discharge in rain of the accumulated vapours of the whole earth did not come down in the heavy drops of the thunder-cloud, but fell in universal and slower measure for forty days and nights, until the electricity accumulated above had again been liberated. As rain begins to fall and to increase when lightning is nigh ceasing, or when electric discharges have taken place, so it was then that the sheet of water, spread out on high over the earth, began to lighten and to disperse, that the sun again broke forth through the dissolving veil; and from that moment the windows of heaven were shut, the power had been removed that drew electricity and water from the innermost depths of the earth, and thus also the fountains of the deep were stopped up. Nor were they to be opened again; for, when the earth was dried, mists were no longer the only accumulation of moisture; the constitution of the earth had been changed, and henceforth, clouds were to be formed to bring refreshment and carry blessings all over the face of the

earth. When thus, after the Deluge, Noah had left the ark and was occupied in the cultivation of the restored land, mists again began to rise; but from the altered electric organization of our globe they rose high and formed into clouds; and fearful perhaps, lest they should gather together and again send the devastating current over the earth, God took away his fear and told the second father of mankind, that He would no more waste the earth by the waters of a flood; and as a pledge for His assurance He said to him: "This is the sign of the covenant which I give between Me and you. I will set my bow in the clouds, and when I shall cover the sky with clouds, my bow shall appear in the clouds." And thus it was that God, for the *first time*, decorated the *first-born cloud*, though dark and threatening, with the arch of peace, with the glorious rainbow, to us still, as it was to Noah, the seal of the covenant, that the waters of the earth, above and below the firmament of heaven, will no more be gathered into a shroud for the human race.

From the time that Noah went into the ark nothing but water once more covered the earth, nor retired from the land until a revolution of one year and ten days' time, within the earth and on its surface, marked the progress and final abatement of the deluge. During its prevalence the subterranean agency was not idle that originally heaved up mountains and separated the dry land from the water; continents, countries, islands, and mountains, risen perhaps and fallen already during the 2,000 years that preceded the Deluge, rose and sunk again and again, here of a sudden, there by degrees; monsters of the deep were carried up within mountains of the soil and clay upon which they had roamed and in which now they became embedded and entombed; forests sank and were swept away where forests had perhaps sunk or been swept

away before, to be covered again by falling hills or buried under floating masses; the waters of the flood filled every recess, every abyss, as well as the craters and openings of the highest mountains; they extinguished the fires of numberless volcanoes and stopped up the pores of the earth; and whilst they remained, ample time was given for gigantic deposits and quiet sediments of various kinds; for, once at their height, the waters of the deluge were disturbed only by the waves of an agitated surface, by the ebb and flow of the tides, and the flood settled down, perhaps, and retired from the land, in a dead calm, until its final abatement.

Since then, in proportion to the disturbance of the former electric organization of the earth, and the alluvial deposits that had been formed by the Deluge, and in which alone remains of existing animals and of man are found, its climate began more sensibly to vary; negative electricity, the representative of warmth, was more driven back and more closely confined at certain places within the earth; and where this had been the case, and perspiration impeded, positive electricity, the representative of cold, came down in greater accumulation upon the earth; and as the former retired from the plants it had luxuriantly raised up, the latter came to embrace them in its withering grasp. If before the Deluge the crust of the earth was not more spongy, porous, or loose in matter than after it; and that by alluvial deposits and chemical precipitation it did not increase in thickness; or that the interior electric action and evaporation of the earth was not more active when in early times the climate of the earth was hotter than it is now at the torrid zone: was it perhaps that then the earth was altogether nearer to the sun than it is at present? Henceforth, however, the size and life of plants and animals began to diminish in the now colder regions, as it diminishes from the valley to the mountain-top. Negative

electricity, reduced in its exhalation from the earth both as to time and quantity, does not sufficiently long and powerfully enter into the plants so as to make them grow to the height and extent to which they grow in hotter climates, nor does it in this limited state infuse sufficient warmth into animals, to make them enlarge into the size of those of the tropics. When the electric element is excited within the earth by the heat of the sun, it issues from the earth, and is conducted upwards into the air by the vegetable creation; but it also enters into the plant itself, drives it upward, and, excited by the sun, causes it to live and to attract from the air all the substances required for its growth, its leaves and flowers, according to the order and design which God had laid down and hidden within the seed.

Thus, by this simple element and operation, we see everything grow and ripen. Living in electricity, exteriorly and interiorly, every blade of grass, every leaf of bush or tree becomes a conductor, from which it readily emerges into the air; but the flower, the berry, the ear of corn, the apple and the pear, not being of so pointed a form, afford no such ready escape into the air; their rounded shape retains it, and for this reason a certain activity is excited, and more warmth produced; and this warmth ripens flowers and fruit, which, when sufficiently saturated or combined with electricity, are repelled by the stem that bore them.

Instances are not wanting by which my theory is proved. "The celebrated Duhamel du Monceau states," according to Dr. Lardner, "that silent lightning, unaccompanied by wind or rain, called heat lightnings, have the property of breaking the ears of corn. Farmers are well acquainted with this fact. On the 3rd of September, 1771, Duhamel himself witnessed this fact: on the morning of that day there was much lightning, and he afterwards found that all the ears of corn which

were ripe were broken off at the nearest knot: the only ones which remained standing were the green ones."

We here see, in a more active degree, the usual operation of electricity on plants, both exteriorly and interiorly. As long as the plant is green, every part of it is connected by the sap of its veins, and held together by the electricity by which it is pervaded. When the ear is ripening, the sap in the fruit drying up and the grain beginning to harden, the interior conducting substance is weakened, the grain by degrees peels off from the vessel that holds it; and electrified by the electricity exteriorly rising up and accumulating round the ear, the matured corn is suddenly thrown off on occasions like the above, when the electricity rising from the earth becomes particularly excited.

"These and similar effects," Dr. Lardner continues, "indicate an influence emanating from the ground. Such effects are not confined to corn, but probably extend to all vegetable substances. The following fact, as stated in the *Bibliothèque Britannique*, of Geneva, for the year 1796, supplies an example of this:—

"A wood of oak situated on an eminence two leagues from Geneva was barked in May, 1795. This operation can only be effected in the season of the year when the sap, moving between the wood and the bark, diminishes sufficiently the adherence of the latter to be enabled to be separated with facility from the tree. The workmen remark also, that the state of the atmosphere produces an evident influence on the process.

"One day the wind was blowing from the north and the sky unclouded, the bark was removed with more than usual difficulty. In the afternoon, clouds rose in the west, thunder rolled, and at the same instant the bark, to the great astonishment of the workmen, fell spontaneously from the trees.

They soon had reason to ascribe this to the state of the atmosphere, since the effect ceased when the storm passed away.' ”

As long as the wind was blowing from the north, and the air cold and without any electric accumulation, the electricity residing within the tree was driven back to the heart and to the earth, as it is in autumn ; and as it withdrew and became contracted, so it drew all parts of the tree closer together, assisted by the pressure of the atmosphere ; and hence the difficulty of removing the bark. Without the air even becoming warmer and more filled with electricity, but an electric accumulation taking place in the sky only, causing but a temporary electric disturbance, the negative element within the earth and trees became active and excited ; it panted to be set free and to unite with the positive element above, and expanding in proportion to the superior excitation and attraction, it almost by itself, without the aid of the labourer, drove off the bark from the body of the tree.

When corn and grass have been beaten down by the rain, the force of gravity has overcome the power of electricity within, and the cold of the rain has driven it back towards the ground ; but when the rays of the sun fall again upon the prostrate stalk, the cold vanishes, the rain-drops dissolve, electricity is again elicited from its retreat, or freed from its contraction ; it re-enters the plant, expands in the warmth of the sun, and tending to rise towards the electricity of the superior regions, it raises up the fallen legions of the field, lifts up and elevates their drooping heads. If however the corn, or grass, or flowers, be ripe, or dry, or broken, they will no more rise when prostrated by the storm, because the conducting sap has been absorbed or scorched away, because the connecting link is withered, severed, not merely bent or weakened.

In his theory of sleep, Dr. Ashburner says: "The sensitive plant exhibits, under two different conditions, the opposite states of sleep and vigilance. Its contracted leaves are in a state of spasm,—a grasping, active, apparent quiescence; and when its leaves are open and expanded, it is awake." And this he very aptly compares with the two opposite states, with the sleep and vigilance of man. But what is it that produces these states in plants? It is the electricity retiring into the deeper recesses of the plant at night, contracting all its members, as was the case with the oak-trees mentioned above, and re-entering or expanding again into its extreme parts as soon as the morning sun, or the warmth of day, arouses it from its sleep by its electric touch. And how beautifully is this operation not represented by the opening and shutting of the convolvulus! by the sunflower, which then even remains turned to and following the sun when clouds are passing between!

But plants in their origin, growth, maturity, and fruitfulness, exhibit to us the beneficial effects of the solar emanations.

At the time of new moon, when the moon in conjunction stands between us and the sun, she withholds from the earth that vast proportion of solar rays and heat which fall upon her back and are absorbed by her body. This deprivation produces a low state of activity on the earth, the lowest during the month. If seeds or plants are then put into the ground—everything else being the same—they will have the benefit of ever increasing light and warmth, as by degrees the moon moves away from under the sun, allowing more and more rays of light and warmth to fall again on the earth until she has reached the opposition, until she is full; the seed or plants will therefore thrive under this gradually increasing, genial, and invigorating influence. If, on the contrary, seed and plants are put into the ground at full moon,

they will germ and take root at the time of the greatest terrestrial electric activity; and as the moon will then decrease and thus begin more and more to abstract from the life of the earth, to deprive us in an increasing ratio of a proportion of solar rays and heat until she has completed her lunar month, the plants will languish for want of good food as it were; the stimulus that attended their birth is not only not kept up but diminishing, they are stunted immediately after they have taken root or begun to live, and thus they will remain sickly.

Vegetation and animal life (and birds in particular, at the time of a great eclipse of the sun), thus influenced by the sun, flowers and blossoms open to him their bosoms, in order that fructification may take place, that the multiplication of their seed and kind may be insured by electric agency and electric incorporation. For, electricity, as stated in the beginning, is incorporated with every created substance, and liberated again by dissolution or combustion; we take it with our food, imbibe it with our drink, and inhale it with our breath. It is the fire which is latent in all ponderable matter, the most closely fettered in metals, and the most loosely allied to spirit and ether. It reposes in the mineral lodes of the earth, in its fields of coal, and beds of turf, and is embodied in every tree and plant. Of alcohol, in equal purity and composition of 52.23 carbon, 13.01 hydrogen, 34.76 oxygen, produced from every variety of grain, fruit, berry, and juice, it is the essence; it exists in the oil and tallow of the animal and vegetable creation; man skilfully concentrates it in gunpowder for the destruction and chastisement of his own species; by the bee, the pattern of order and industry, it is collected, so that, hidden within the virgin wax, an emblem of faith, it may illuminate the altar of God, burn and shine in honour of Him who Himself came to be the light of the

world, and by Whom it first was created ; on being kindled it starts from its repose and breaks out into fire, and, amalgamating with the electricity bound up with the oxygen of the air, will continue to flash and to flame until the body from which it is evolved or from which it emanates, is dissolved, consumed, or exhausted.

We have seen already how exterior and interior electric currents drive up the plants and cause them to abstract from the air the nourishment which they require. Flowers and fruits, owing to their rounded forms, retain longer these electric currents, whilst readily escaping from the pointed leaf ; hence they are subject to greater electric activity, particularly on those spots or parts which are shone upon by the sun. This activity attracts in greater abundance from the air the substances they require, as also those which form the various beautiful colours and bloom by which we are charmed, and which so often make us adore the goodness of God and admire the beauty of His designs. And can we *sufficiently* appreciate and admire His power and wisdom in producing all this by the simplest of means !

Meteors of every description, the metallic bases of plants living entirely in the air, have shown us already that the air is filled with metallic solutions, chemically combined with oxygen, perhaps free, perhaps in both states. The analysis of meteoric stones shows nothing foreign to what is contained in the earth ; in them we find, according to Berzelius, eighteen simple elements ; viz., oxygen, sulphur, phosphor, flint, aluminium, magnesia, calcium, kali, natron, iron, nickel, cobalt, chrome, manganese, copper, zinc, and titan. All these are highly magnetic ; and each one thus attracted according to the electric organization of every plant, the metallic atoms settle down upon leaf, fruit, and flower, in the order and arrangement devised, and the pattern traced and delineated thereon by God ;

and moistened by interior sap, by dew, and rain, and again shone upon by the sun, oxidation takes place, the solar rays corporify, yielding to our eyes the most magnificent variety of colours, such as human chemistry has not as yet been able to produce. And yet the constitution of plants may still be found out, as also the constitution of animals ; why one plant absorbs the cobalt, another the chrome, another the copper, and why others should absorb the arsenic or other poisons that may float in the air ; why one animal should be attracted to feed upon one, and the other upon another plant ; why chemical operations on the plant produce a change of colour in the flower by changing its electric constitution, its quality, and power of attraction, etc. What wonders of Divine Wisdom will not be manifested when science shall have attained this eminence ! When from the most minute to the most gigantic object in nature, from organic to animate creation, from the growth of the insect to the growth of the elephant, from the course of the fishes in the water to the passage of the birds in the air, we trace nothing but the simplest of means : electricity in repose, electricity in its currents, electricity free and electricity accumulated, electricity divided in cold and warm,\* electricity in silent action and amalgamation, and electricity in explosions of fire.

\* Baron von Reichenbach seems most singularly to confirm my supposition respecting the nature of the two electricities in respect to warmth and cold. Speaking of the magnetic nature of crystals he says : " Every crystal presents two points, which lie always diametrically opposite to each other ; they *are the poles* of a primary axis of the crystal. Both poles act in the same way, but one always much more strongly than the other, and with the distinction that from one there appears (to sensitive persons) to issue a cool ; from the other a softer, gentle warm (seeming) current of air. The magnet when drawn over the hand of a sensitive person, produces the same sensation of cold at one pole, and of gentle heat at the other pole. In regard to quantity

In the life of plants, of the animated creation, in the composition or dissolution of almost every thing that presents itself to our notice, electricity, with its attractive power of whatever comes with more or less affinity within its reach, the metallic solutions which fill our air, and oxygen, seem to be, of all bodies, the most intimately interwoven. Nothing is more strikingly acted upon by electricity than metals, and nothing more readily oxidises, or comes under the influence of oxygen, than metals. Hence we may conclude, that metals in a state of undefinable solution are always in a state of amalgamation with oxygen, and that in this state of amalgamation, electricity, as in all cases, is the binding element of the body, the cement of the cement, whether that body be in a gaseous, fluid, opaque, or solid condition, and that it depends on the degree of electric excitation and amalgamation as to what state or property certain proportions of matter, or substances, are to assume.

In feeding upon metallic solutions derived from the air by plants, and no doubt by ourselves, and by animals on land and in the water, it will be evident according to the above, that the solutions could not be absorbed, could not be inhaled without the necessary portion of, or combination with oxygen, and that, living by the inhalation of oxygen, we must necessarily inhale some portion of metallic matter, determining, perhaps, electrical operation always united, the various state and colour of the blood, the sap and juice of plants, etc. Thus, the preceding trio seem to be inseparably connected; and having treated already at large upon electricity and tried

the north pole is stronger and the south pole weaker; in the crystal the northward pole is stronger, and the southward pole weaker."

Joyce, page 482, says: "The thermo-electric apparatus has been employed to prove a case in which electricity produces cold: as when a feeble current passes the junction of bismuth and antimony."

to prove the metallic state of the ocean of air we live in, it still remains to demonstrate, if possible, where, in the economy of Divine Providence, the important element of oxygen is derived from.

At the beginning of this little work I have already spoken of the certainty of oceans of different matter existing beyond our own atmosphere of air ; and these oceans, or rings, which surround our globe, are but ulterior rings and strata of a system of construction which begins within the earth itself ; for the earth, as geologists have shown, is composed of rings or strata, which, as we leave the interior, become lighter and lighter in substance the nearer we come to the surface ; and this surface is girt by an ocean of water, and this again covered by a lighter ocean of air. Hence we may reasonably conclude, that the higher oceans are progressing in lightness, expansion, and elasticity, in proportion to their reaching the boundary of our sphere.

That of these oceans one is of oxygen, I am the more inclined to believe, as the supply of this gas has, as yet, not been accounted for ; that it is the first and next in order after our own atmosphere of air, I hope to be able to establish.

Oxygen is a body, a gas, which scientific men have, as yet, not succeeded to decompose, though several beginnings have been made. In nature we meet with it in every form, but in the air we find it in its most simple state.

The air itself is composed of two gases, of which seventy-nine parts are nitrogen, or azote, which means destructive of life, and twenty-one parts of oxygen, or vital air ; and these two gases are almost evenly mixed throughout the whole ocean of our airy atmosphere, of which oxygen is the leaven. Oxygen, in fact, is the all-pervading life-giving matter of this our terrestrial globe ; no human being, no animal, whether

of the air, water, or earth, can live, nor can plants grow without it; and, like electricity, it seems to unite, or to be in a state of incorporation, more or less, with every created substance. By this incorporation, the oxidation of inanimate matter, by the process of respiration of man, animals and plants, by consumption through fire and other causes, so much is used and withdrawn from the air, that it is truly wonderful, how the supply keeps pace with the demand, and that too with a regularity hardly conceivable. It is one of the masterpieces, if we may say so, of the God of Creation, of Him who needed no counsel in the arrangement of His works.

Azote, or nitrogen gas, the great bulk of our atmosphere, science has not been able to dissolve, or decompose, no more than oxygen; it enters into chemical combinations with oxygen in different proportions from that in which it is mixed with it as air, forming nitric acid, etc.; but otherwise it is not known to suffer any diminution; and hence we may conclude, that it is the permanent part of our atmosphere, through and with which we inhale oxygen in that proportion which is most suitable to our existence.

Oxygen, then, is the variable, the constantly consumed and abstracted part of our atmosphere, or more correctly speaking, of the air; and unless my theory be correct, it will as yet have to be found out, by what law it has pleased Divine Providence to produce or renew, and from what chamber of His laboratory to furnish us with this indispensable, vivifying element. From appearances, we should suppose, as we shall see, that the supply comes from above, from beyond our own atmosphere, though the results of chemistry certainly seem to be against this supposition. But then, chemistry has still to divide both nitrogen and oxygen.

There are bodies which contain very large quantities of

oxygen, and in particular manganese; from these bodies it is driven off by heat, and by being heated to a high degree, others will again absorb it. By this, and other means, scientific men have been able to collect and weigh this gas; and they find, that 100 cubic inches, at a medium temperature and pressure, weigh 34·4 grains, whereas an equal column of atmospheric air weighs only 31 grains; and azote, or nitrogen, the residue of the air after being deprived of oxygen, to weigh only 30·20 grains.

Supposing these results to be correct, it would certainly seem strange, that oxygen, the heaviest of the three bodies, should form an ocean above our atmosphere; it would be something like water floating upon oil. It must, however, be borne in mind, that oxygen, unlike water and oil, is a rarefied and elastic body, and that the oxygen measured and weighed by scientific men, has, moreover, been obtained by artificial means; and the question therefore arises: Is it as pure as that which floats in our atmosphere or above it, particularly seeing, that water, however pure, differs much in weight? How will pressure and temperature *here* and *above* relatively influence its density? Professor Schönbein, some years ago, discovered "ozone" in the atmosphere, a gas, which by some is considered a compound of hydrogen and oxygen, by others oxygen in a highly excited state. Mr. Auguste Kouzeau has also succeeded in obtaining a very odoriferous gas, said to be dangerous to respiration, from oxygen. Does not this, in some degree, bear out already my theory?\* May not oxygen form some undetected combination by coming down into our atmosphere? Indeed, it seems

\* Since this was written Professor Schönbein has followed up his important discovery; and it is now a fact, confirmed by Dr. Faraday, that oxygen is a compound of ozone and ant-ozone, gases, the more perfect knowledge of which may lead to most extraordinary results.

to me very likely, that nitrogen, the bulk of our atmosphere, is an undetected compound, of which the heaviest part unites with the oxygen coming from above, and thus facilitates its descent to the earth. But still more probable does it seem to me, that oxygen unites with the metallic solutions with which our atmosphere is charged, and thus sinks easily down to us with uninterrupted regularity ; hence also its greater weight over that of the air, or nitrogen, by themselves. If, on the other hand, oxygen is really heavier in its free state than air and azote, there will be more difficulty to account for its rise in even proportion to the greatest height against the law of gravity, than to account for its descent on my proposition. Or, if it rise like vapours from the earth, to form into clouds and come down again : whence does it rise ?

Taking, then, for granted, that, in its pure, natural and expanded state above, it is lighter than air, the same as air is lighter than water ; and that in this assumption I am borne out by the evidence which I shall bring forward, I will now try first to show, that, as a source of supply, oxygen is not contained in the earth, nor in the water, nor in the air.

As a source of supply, oxygen does certainly not seem to be contained in the earth, or to evaporate from it, in the state in which we breathe it ; for, if you dig a well or pit, it will by degrees escape from the air with which it was mixed and leave nothing but azote behind, a substance, in which neither human being, nor animal, can live, or fire burn ; and in thus separating from the air, it either creeps into the wall of the pit or well to form some oxidation, or it rises again into the light of day. It is the same with mines that are not worked, or badly, or not at all ventilated ; and if our supply of oxygen came from the earth, this would not be the case, and the well, pit, or mine, would never become foul, and dangerous to human life.

The lower strata of the air are always, more or less, charged with deleterious matter, which, partly as miasma and contagious gases, dangerously affect the animal organization; there are fogs which give a peculiar smell, and which, according to Humboldt, remind us at certain times of the year, of those accidental mixtures of the lower air.

Now if our supply of oxygen came from the earth, though united with various metals it forms the greater part of the crust of our globe, it stands to reason, that the strata of air nearest to the earth would always be as much, if not more, charged with it, as the upper regions, notwithstanding the exhalation of other matter, and the stagnation of the air in so many places, both above and below ground; for, the oxygen would there be fresh, and by its constant escape upwards keep the air healthy and clear like a rivulet at its spring. Nor is it likely, that, with an almost constant deposit of carbonic and other gases, and matter floating over the surface of the earth, God should have chosen to convey to us, through this dead sea of impurities, that element, on which life itself depends, and that this element should more be shrouded in corruption at its source than at the greatest, or any, distance from it. If, again, it came from the earth, it would also have a tendency to return to it, like rain and dew to the waters from which they rise, and not, in its pure natural state, ascend and remain, in greater proportion than below, higher than it has been given to man to ascend. But the earth draws its supply from above, and amalgamating with it by the process of oxidation, holds it bound, and only allows it to be freed again by force; it is more inclined to unite with solid bodies under certain conditions, than to escape from them when once it has formed the combination. Hence the oxidation of our globe, of whose ponderable matter nearly one-half consists of oxygen; and this oxidation would not

have taken place, nor be going on, if, instead of absorbing this element like all living and inanimate bodies, from the air, it were to supply them all, and the air too, from its own substance, unless it could be proved, that there was an inexhaustible supply within the earth itself, and that at any time, place, or particular conditions, it was evolved by it into the atmosphere.

It is said that plants, and flowers in particular, at times exhale this extraordinary gas; this, however, must be very little, inasmuch as, like living beings, they always absorb the oxygen of the air, or of the water, in which they grow, to be incorporated with their sap, the same as it is with our blood. If flowers over night produce such an atmosphere in a room, that a person sleeping therein will die from its effects, like from the effect of burning charcoal: it is, that the flowers, as well as the walls of the room, absorb perhaps all the oxygen of the place, leaving nitrogen, charged with the carbonic odour of the flowers, behind, just the same as a charcoal fire in a closed apartment. In daytime, when the air of a room is more or less changed by the opening of doors and windows, no such effect is perceived, and hence, no doubt, has arisen the belief, that flowers exhale oxygen by day, and carbonic acid gas by night.

Oxygen promotes our breathing, fast breathing accelerates the circulation of the blood, and a rapid flow of the blood causes perspiration. And is it not the same with plants and flowers inhaling oxygen as it were, that they perspire after rain and dew, particularly when followed by sunshine, from increased activity of life? This activity is manifested by their erected carriage, by electricity raising up their drooping heads and limbs, sustained, refreshed, and nourished by the oxygen, which in combination with metallic solutions have been attracted and absorbed.

Oxygen gas is evolved by the action of the sun's rays on the moistened leaves of trees, which, it is said, by this agency decompose the carbonic acid *diffused in the atmosphere* from various sources, and by combining it with their carbon, flourish and increase in size. Now there are at most, and at times only, but one and a half per cent. of carbonic acid contained in our atmosphere, and this, if decomposed by the aforesaid process, would not go very far to make the leaves of trees flourish and increase in size, particularly those on which the sun never shines. Mere warmth will not have the effect of evolving oxygen from moistened leaves, or from a fresh leaf put into a glass of water; but as the rays of the sun produce this result, they must exercise a kind of fermenting influence on leaves in that state, from which they disengage the oxygen, causing it to appear in the shape of little silvery bubbles, like those that rise from the bottom of a flask of water over a fire. The oxygen thus evolved is no doubt the result of an excess of electric activity produced by the rays of the sun; this emanation, however, can never be regarded as a supply for our atmosphere, for, the process is very partial, short-lived, and at long intervals, and there are many more leaves not shone, than shone, upon by the sun.

Oxygen, as a reservoir for the supply of our globe, does not seem to be contained in water either, from which that part of it, required for sustaining the life of the creatures and plants it contains, is abstracted or absorbed by them, as it is done by us from the air. If this were not so, water, whether in contact with the air, or not, would never become foul, inasmuch as the combination with the life-preserving oxygen would be its unfailing and unvarying condition, and keep it fresh, whatever quantity it might have to give up to our atmosphere. But water will decompose by standing for some time, simply because the oxygen is escaping from it, the same

as the air of an apartment long closed will decompose by the retirement of its vivifying element.

Water is a compound of eight parts of oxygen and one part of hydrogen ; and though this appears almost similar to saying that bread is a compound of eight parts of leaven and one part of flour, yet we are unable to explain the nature of the change which takes place in producing water by means of the aforesaid combination, or chemical union of gases. Oxygen thus converted into water has evidently no longer anything more in common with the oxygen we breathe—which pervades the whole atmosphere and all the waters of the earth as leaven pervades bread, and which is as necessary for the creatures living in the water as for those living on earth—than petrified wood has anything in common with the same wood when green ; the difference between the two is this : that the former is converted in a moment, and the latter by very slow degrees.

If oxygen, on being changed into water, did not change its nature altogether, none of all the creatures living, and plants growing in it, would require any pure oxygen for their sustenance, nor would this gas merely in a mechanical, and not in a chemical, manner, unite with the water. But it is a well-established fact, that river water in particular possesses the property of absorbing much oxygen, and that for this reason the surface of both rivers and the ocean holds more oxygen than the atmospheric air, to the amount even of 29·1 per cent. ; and this it is that contributes to the maintenance of the respiration of fishes and the growth of aquatic plants, the same as required for man, and the animals and plants on land.

Water again, a combination of oxygen and hydrogen, will, at a low temperature, form ice ; but it is not from the ice either, no more than from the oxidized crust of our globe, that we derive the oxygen we breathe. It seems, on the contrary,

that in the formation of ice, the oxygen is excluded and left behind in the unfrozen liquid, to establish, as it were, an additional store for the animals underneath, the ice being a barrier against the usual supply from the air, destitute itself of atmospheric air when first dissolved, and consequently unable to sustain respiration in fishes. Ice-water, for the same reason, the absence of atmospheric air, is mawkish and insipid, but by exposure to it, it speedily absorbs a due proportion. With snow-water it is much the same, and for this reason, no doubt, it is, when drunk, so injurious to the constitution; and frost and cold are evidently as unfavourable to oxidation as warmth and heat are favourable to it. Hence also to nature the particular benefit of a warm rain, and the invigorating influence of dew, which contains still more air and oxygen than rain.

Water also, like land, is covered with vapours of various descriptions, and the same reasons which I adduced for not considering the earth as the universal reservoir of oxygen for the benefit of all things created, will likewise hold good with regard to the former.

That the atmosphere itself is not the great holder of oxygen seems very evident from the decomposition of the air, wherever it may be, unless renewed from time to time.

I have already spoken of how this gas escapes from the air of rooms kept shut for any length of time, whether under or above ground; but, if even a chimney or tower were built a thousand or more feet high, everywhere air-tight save at the top, the oxygen would soon be found to have disappeared from the air within, by either having crept into the wall, or ascended into the regions of light, towards which it is most inclined. Being, in its purely natural state, lighter than the matter with which combined it forms air, it must naturally have a tendency to rise, unless more powerfully attracted by

bodies with which it chemically as well as mechanically unites; and it would, from this reason, leave the whole earth a valley of death, had a good God, who called the world into existence, not ordained that the dew and rain of heaven, and the wind and agitation of the air, should always provide us with it in that nearly uniform proportion, in which almost all scientific men have found it to exist everywhere.

And whence is it likely that the movements and currents of the air should carry to us this element of life? From where else, if not from a reservoir in the regions above, from the highest of which life itself has come?

If water, as I have shown, and as the airbladders of the fishes in particular tend to demonstrate, contains air, and of necessity oxygen, it does beyond all doubt derive it from that ocean of air which fosteringly rests upon its surface; and though the process by which the water sucks in the air from above, drawing down a lighter body than itself, is not known to us, yet we may compare it to apparently solid bodies absorbing moisture, to quicklime feeding upon vapour, until saturated to that degree assigned to it by its Creator for His own purposes; it is, in a certain manner, an oxidation of the water, perhaps an electric suction.

Our atmosphere, in the same manner, absorbs its own lighter part, from a reservoir higher above than itself, and with such regularity, that no consumption, however great, takes place, but is instantly made up again by a fresh supply. As water holds a given quantity of air, with a constant tendency to rise, so air holds a given quantity of oxygen, and this again a defined quantity of still purer matter, perhaps hydrogen, until we have arrived at the limit of our earthly sphere, where a still purer invisible matter, electricity, with its inherent magnetic power, begins to fill up the spaces between the worlds of the universe, and in which

they move with almost the rapidity of thought, directed and sustained by God, the Creator of all.

To facilitate the absorption and incorporation of air by the water, He ordained, that, by the varying pressure of the atmosphere, caused by the disturbing influence of the moon gliding over it for the production of the tides, and by the turbulent action of the breeze and the hurricane, it should be brought more within the wild but beneficent embrace of the air; and the atmosphere itself He provided to be rocked to and fro by the companion of the earth, and to be set in almost constant motion all over the globe by its various currents, in order to promote the absorption of the animating element, and its diffusion in every quarter, and particularly at those places where the air is most liable to decomposition. And these places are unquestionably at the equator, where nature, as it were, is constantly exhausting and recovering itself. *There* is the greatest evaporation of water, the greatest evaporation of electricity, the greatest absorption of oxygen, and the greatest decomposition of the air. When in our own clime, in the heat of summer, owing, no doubt, to the escape of air and oxygen from brooks and ponds, the fishes come up to the surface, apparently gasping for breath: what must not be the evaporation under the vertical rays of the sun at the equator! What clouds of vapour must not cover the sea and the land! What enormous quantities of electricity must and do not rise to produce thunderstorms almost every day! What an absorption of oxygen must not take place there by the vegetable creation with a constant summer and uninterrupted vegetation! And towards the equator it is, that from the poles, where there is no decomposition of air or water, where, in their respective regions, electricity and oxygen exist in their greatest and densest proportion, they are more particularly carried by ceaseless currents.

But also the dew and rain of heaven, as we have seen,

bring down to us this indispensable oxygen, which, owing to the colder state of the higher regions of our atmosphere, is there also in greater abundance than in the warmer and more expanded strata below, the same as it is present in greater quantity in winter than in summer, as evidenced by the brighter burning of the fire at the former season. They will bring it down, not merely judging by the coolness which they impart to the air, but also by the pleasure of breathing on a fine summer morning, or after the rain of a sultry summer day ; it is the oxygen that makes us breathe again and again, as if we could not breathe enough, and it is the oxygen coming down fresh from heaven that causes the perspiration, and dissolves the fragrant gases, of plants and flowers, and makes them fill the air with an odour, as it were, of another world.

It is after thunderstorms in particular, that the air is filled with the perfume of nature ; and this, no doubt, arises from the still greater, than ordinary, quantity of oxygen with which the water is charged. For, apart from the usual cause of rain through the formation of vapours into clouds, the process above, on a grand scale, seems to be that of scientific men below, who have discovered how to convert oxygen into water, and thereby changing its very nature ; hydrogen, like oxygen, rises in part from the earth towards the sphere from whence they have come ; both are united above, and by electric agency formed into that water, to which we owe that more particular delight of an atmosphere, almost overflowing with the sweetest fragrance.

In considering this transformation of oxygen into water, I am involuntarily carried back again to that awful instance, when by this means, and the gathering into one universal cloud of the mists of the earth, the floodgates of heaven were opened, and a sinful generation was swept away.

The Deluge, though vouched for by the tradition of every nation under the sun, is to many difficult to believe ; but

suppose it to be correct, that there is an ocean of oxygen above our atmosphere, as there is an ocean of water resting on the land, and an ocean of air covering land and sea ; that this body of oxygen is saturated with hydrogen from an ocean still higher above, in the same manner that land is saturated with water, water with air, and the air with oxygen ; that, as we have seen already, positive electricity pervades the superior parts of our atmosphere and the whole space of the universe : how easy was, and is, it not then for God, whose laws of nature harmonize, go hand in hand with those of morals, to excite this electricity, and by its silent operation, apart from the common rain, and the gathering of the mists of the earth into one common cloud, to convert, in an instant, and in even a comprehensible manner, an ocean of animating matter into an element of chastisement and destruction. If water is but another name for oxygen, as ice, snow, hail, dew and steam are but other names for water ; and if within the sphere of our globe, that ocean of oxygen with its component part of hydrogen, like a line of demarcation resting upon our surface of air, forms, perhaps, the blue canopy of heaven and grand reflector of light—how beautifully true do not then become the words of Moses : “And God said, Let there be a firmament (an atmosphere of air) in the midst of the waters, and let it divide the waters from the waters. And God made the firmament, and divided the waters which *were* under the firmament from the waters which were above the firmament ; and it was so.”

This theory is strengthened by the following observation of Sir Isaac Newton, who says : “that COMETS seemed to be required *for the conservation of the seas and fluids of planets*, in order that, from their condensed exhalations and vapours, the water consumed in vegetables and putrefaction, may be continually replaced and supplied. For, all vegetables grow

wholly from fluids, and then are, to a great extent, turned into dry earth by putrefaction, a slime perpetually settling from putrefying fluids. Hence it is that the bulk of the solid earth is continually increasing, and that its fluids, if not supplied from any other source, must constantly decrease, and at last, entirely fail. I suspect also, that the comets supply our air with that which is the smallest, and most subtle, and useful part of it, and which is required to sustain the life of everything."

Who does not see, that the functions here ascribed to COMETS are more naturally performed by the oceans of oxygen and hydrogen above, yielding their supply to the solid earth until it shall please God to consume it by fire, fed by the oxygen which it received through the air.

It is also worthy of notice, that of the superincumbent oceans of air, oxygen and hydrogen, the air, as a general rule, but always when cold, should be positively electrified; that oxygen in its uncombined gaseous state is attracted by the positive, and hydrogen, in its uncombined gaseous state, by the negative pole of the voltaic battery; that therefore the electric state of these bodies is calculated for the functions they have to perform, oxygen being negatively, and hydrogen positively electrified. Owing to the extraordinary absorption of oxygen and hydrogen by the earth, it is not to be wondered at, that the ocean above us should by degrees diminish, in bulk or density, however little, in a given time; and to this diminution, both of the oceans of oxygen and hydrogen, we may no doubt ascribe the moon's acceleration, that is, her gradual, though slow, approach to the earth.

It seems natural, that, by the manifold operations in nature, by the various pressure of the moon floating on the oceans above us, by storms, and winds, and phenomena of different kinds, the presence of oxygen in the air should not

be as even everywhere as has generally been believed ; there are too many causes to operate against this permanently even distribution. Humboldt also states, that from observations made by Levy it has become probable, that according to seasons, the situation of places in the sea or in the interior of continents, the presence of oxygen varies a little, but sufficiently so as to be noticeable. He also states his own view to that effect, and mentions, that Martin, at a height of 8,226 feet, did not find the air he had collected poorer in oxygen than the air of Paris. Gay-Lussac, in one of his balloon ascents, brought down air from a height of 22,000 feet, or more than four miles, with the same result.

The two instances cited above are not exactly adapted to show the variableness of oxygen in different parts of the air, but they are the best proof that this element exists in the air in undiminished proportion at the highest altitude that has been ascended to, and one of the best evidences in favour of my theory.

Electricity, as it has the power to convert oxygen and hydrogen into water, so it possesses the power to evolve both oxygen and hydrogen from water. But all those instances in which these gases are liberated from solid or liquid bodies, and rise into the air, are exceptions to the general rule ; and it cannot be said that by these means our atmosphere is provided with the one and the other ; we then must necessarily go higher for our supply.

Meteors, and in particular the aurora borealis, of which I have treated already, and which has been calculated to rise from 50 to 600 miles, and the one simultaneously seen at Rome and at Paris, on the 16th October, 1726, to have had an elevation of 800 miles,\* do, no doubt, owe their brilliancy

\* For many most important facts and ideas I am indebted to a work published in numbers, at Munster, in Westphalia, under the title of

to the reservoir of oxygen, within which, or in whose vicinity, they make their appearance; their various light, intensity and duration cannot be ascribed to an electric explosion or amalgamation in vacant space or rarefied air only, there must be some other body to cause their diversified appearance, and this body can be no other than oxygen, giving lustre to electric metallic combustion and conflagration.

Thus, within the solid body of the earth, upon and exterior to it, we have seen the existence of electricity and its operation, though but clumsily represented and illustrated; yet upon the evidence brought forward, until shown to the contrary, I think we may consider as true my propositions, viz.: the existence, *per se*, of positive electricity without, and negative electricity within, the solid part of the heavenly bodies, if our earth be a pattern of all. But we have a further, and still greater, proof of this separation and distribution of the two electricities in the variation and the dip of the magnetic needle.

When treating of thunderstorms, of the aurora borealis, etc., we have seen, that the sun exercises the greatest, if not exclusive, influence on the electric condition of the heavenly bodies moving within his sphere. Exterior to the solid body of the earth he causes an electric tide, an apparent electric current from east to west; and the exterior electric condition always corresponding with the interior one, the effect is manifested in the variation of the magnetic needle, though in many instances caused by the substances which in different places form the crust of the earth, facilitating or obstructing, according to circumstances, a liberation of negative electricity.

"Nature and Revelation" (Natur und Offenbarung), and I cannot sufficiently recommend this publication, which in England is to be had through Messrs. Williams and Norgate, London.

The earth being warmed by the sun, and the sun's rays accumulating on its surface, we experience the greatest heat a few hours after he has passed the meridian. As cold increases, so heat, by its expansive power, decreases, or diminishes the electric density. Thus, the solar heat reduces the positive electric density of the air, as well as the negative density of the earth, and when at its highest, produces electric low tide, or the local evening minimum of positive electric intensity, with its contemporary liberation of negative electricity, and consequent local diminution of the electric intensity of the earth. On both, the west and eastern sides of the sun, that is, on the sides of electric low tide, occurring about two hours after the culmination, after mid-day, there will be a corresponding electric high tide, or the morning and evening maxima, leaving between them again, somewhat after the midnight part of the earth, a natural electric state, a morning minimum, similar to the tides produced by the moon upon the ocean, though, owing to the absence of the sun at night, the morning minimum of electric intensity of the air causes *no corresponding diminution of terrestrial* electric intensity; and as the earth turns round, we pass from the atmospheric electric maximum to minimum, from minimum to maximum, and from that again to minimum, according to our gradual approach to, or recession from, the sun. The values of the intensity of the electric tide have been very accurately ascertained.

Dr. Lardner, speaking of the variation of the electricity of the air, says: "As the diurnal change in the position of the sun, relatively to a given place, produces a periodical variation in the electric state of the air, the change of its declination, from month to month, may be expected to be followed by some corresponding periodical effect on the mean amount of the maxima and minima values of the electricity. On com-

paring the mean values from month to month, it is accordingly found that the values of the daily maxima and minima undergo a progressive decrease from January to July and a progressive increase from July to January. It is found, also, that during the winter the electricity of the air increases as the thermometer falls.

"On comparing the mean values of the maxima and minima throughout the year, it is found that the morning values of each are a little less than the evening values.

"The hours at which the electricity attains its maxima and minima values are, likewise, subject to variation from month to month. The hour of the morning minimum and maximum continually advances towards noon from winter to summer, and undergoes the contrary change in the latter part of the year.

"The observations of Schubler indicate that the hour of the evening minimum is invariable. From June 1811 to June 1812 it took place at Stuttgart always at 2 P.M. The hour of the second maximum also gradually approached from summer to winter, and receded from it again from winter to summer."

All this agrees with the theory I have laid down: positive electricity diminishing in intensity, and withdrawing, as it were, from the earth, according to the warming and expansion of the air by the heat of the sun, and the consequent liberation of negative electricity from the earth. Hence also the local variations of electricity.

In the most elevated places, and in those which are best insulated, heat cannot accumulate; and accordingly, Saussure has shown, that *there* the positive electricity of the air has greatest intensity. In the midst of squares and other open spaces in cities, on the quays, but especially on bridges, it is even more intense than in an open flat country, as Dr. Lardner

informs us, because here likewise the air cannot become warm on account of its constant change and motion. In particular localities, such as Genoa, where fogs prevail which lie low and are not converted into rain, the positive electricity, according to the same authority, is not intense, but also, because the rays of the sun not falling and accumulating there upon the earth, the air can neither become warm, nor can negative electricity be liberated from the earth, whilst positive electricity concentrates in the vapours which compose the fog. On the other hand, in the interior of buildings, under trees, in the streets, courts, and other inclosed and sheltered parts of the towns, no free electricity is found in the air, because the air is warmed either, by the sun, or by animal heat and the fires of domestic life, without its being renewed by atmospheric currents, in fact, by ventilation, to supply the positive electricity which has been dissipated, or to counteract the negative electricity rising from the earth, floating on the surface, settling in buildings and congregating under trees as its natural conductors, and which, as we have seen already, enfeebles and depresses the human frame, whilst positive electricity promotes and strengthens the action of life. Hence, apart from the supply of oxygen, ventilation is of the utmost importance for keeping the frame of the human body in a vigorous condition.

The correspondence between the diurnal and mensual variation of the electricity of the air and of the earth, and the diurnal and mensual variation of the magnetic needle, will easily be perceived.

From observation it appears, that in a given place, the north pole of the needle begins to turn westward at seven or eight o'clock in the morning, and continues to deviate in that direction till about two o'clock, when it becomes stationary, and soon begins to turn eastward, arriving at the position it

had in the morning, at the same hour in the evening. Canton's observations showed that the amount of this deviation varied from seven to thirteen or fourteen minutes, being greatest at midsummer, and increasing and decreasing gradually between these seasons.

From this it will be seen, that the times of greatest eastward and westward variation correspond nearly to the times of morning maximum and evening minimum; but there are no effects exhibited by the needle corresponding to the evening maximum and morning minimum.

According to what has been said before, we know that the electric tide, the greatest electric intensity of the air, precedes and follows the course of the sun. Thus, when at the morning maximum the north pole of the magnetic needle begins to turn westward, it follows the maximum, or high tide, which precedes the sun; but the moment that the evening minimum (two o'clock), which likewise is the time of greatest liberation of negative electricity from the earth, has passed, the evening maximum gains upon the needle, which, having just escaped the grasp of the morning maximum, gradually returns eastward to meet again the morning maximum, unaffected by the morning minimum. This however does not, in reality, seem to be the true statement of the case.

The electric condition of the atmosphere, upon the whole, corresponds all over the earth with that of the interior of the earth; yet, the electric tide caused by the sun, effects no corresponding change, or tide, as we have seen already, within the earth; the only change produced during the day amounting only to the liberation of negative electricity from the earth by the sun, and the consequent diminution of its interior electric intensity at the place of liberation. Thus, the magnetic needle is not in reality influenced by the

electric tide of the air, though it appears so; the evening maximum and morning minimum of the electric tide of the air not in any way affecting it, must be evident proof that its variation does not proceed from the electric state of the air, but from that of the earth.

This state of the earth, as we have seen, undergoes little, if any, change at night; but in the day the electric intensity is diminished; and as the electric density of the air as well as that of the earth is greatest, when it is coldest, the needle, disturbed, as in the case of the aurora borealis, by the electric evaporation caused by the solar heat, turns alternately to the interior, colder and more intensely electric part on either side of the sun. After the evening minimum, the eastern side of the earth is coldest and most intensely electric and magnetic, and after the morning maximum the western side is coldest and most intensely electric and magnetic.

The diurnal changes of the magnetic needle are greater and more irregular in the northern regions, because the intensity of electricity is there greatest, and the disturbance of its balance consequently more powerful, while towards the line the variations gradually diminish, and at length disappear, because the density of terrestrial electricity becomes less and less, until it ceases to affect or to attract the needle as we approach the equator, owing to the greater, more regular, and uninterrupted liberation of negative electricity from the earth by the heat of the sun.

The mensual change is an alteration in the direction, according to the season of the year, by which the needle, during the months between the vernal equinox and the summer solstice retrogrades towards the east; and during the remaining nine months preserves its general tendency towards the west. And this change agrees with the progressive decrease and increase of the intensity of the electric tide from

winter to summer and from summer to winter, as well as with the hours of maxima and minima, which continually advance towards noon from winter to summer, and recede from summer to winter, in proportion to our days getting longer or shorter, warmer or colder.

The eleven-yearly magnetic period which has been observed, is unquestionably due to the change in the solar spots which Schwabe discovered to take place within about that time, and which naturally must affect the climate of the earth.

Besides these comparatively regular, daily, monthly, and eleven-yearly variations, there are others of an irregular character, which are due to adscititious causes, present only under peculiar circumstances. Chief among these disturbing causes is the aurora borealis, during the prevalence of which the needle is considerably disturbed. Mr. Becquérel says: "Generally, the declination increases before the aurora, and often even until the phenomenon has attained a certain degree of intensity; then the great oscillations commence; afterwards the needle returns towards the east very regularly; it passes beyond its normal position, which, providing no new aurora disturbs its progress, it regains again, although not until some hours have elapsed."

The accumulation of electricity, both positive and negative, required for the formation of the aurora borealis, sufficiently accounts for the increasing declination of the needle before the aurora has commenced; the needle is attracted by the increased density of the electricity of the earth, and liberated from its hold by the amalgamation of the two electricities, by the neutralization of their power; and this neutralization, the explosion of the electric elements, produces an exhaustion of electric intensity, both of the air and the earth, which in turn causes the needle to be attracted from a greater distance by the electricity of the earth, and makes it pass beyond its

normal position until the usual electric equilibrium has been restored, and the needle retired to its original direction.

In confirmation of what I have said, I may add, that Hansteen found by experience, that shortly before the commencement of the aurora borealis the magnetism of the earth is of an uncommon force or intensity, which, however, soon after the beginning of the aurora borealis decreases, and sinks down under the usual force. And on the occasion of an aurora borealis seen on the 19th December, 1829, at Alford, in Aberdeenshire, a most striking disturbance in the direction of the declination of the magnetic needle was simultaneously observed, not only on the earth at Berlin, Petersburg, Kasan, and Nicolajew, but also deep under the earth at Freiberg, in Saxony.

Whether the aurora borealis itself is in any way connected with the electric tide, I have not been able to ascertain.

That earthquakes and volcanic eruptions disturb the needle we have already seen before.

Owing to the undulated character of the surface of our earth, the construction of its crust, the various materials which here and there lie uppermost, even the position of its seemingly confused strata, the liberation of negative electricity from the earth varies in almost every place; hence also, in the words of Dr. Lardner, there is a given declination, or deviation, from the true north, or a given direction of the needle, proper to each spot of the earth. That this *declination* is influenced by place, *i. e.*, by change of latitude, or longitude, or both, is acknowledged by Lardner, who says further on this point: "It is found by experience, that this relative declination bears no regular ratio to the change in latitude and longitude, but is governed by other laws; and so irregular is the rate of variation, that it is not easy to foresee the precise effect of a change of place; so that

nothing but actual observation avails for the construction of tables showing the declination in different places; or at least, no calculations can be confided in, unless well confirmed by observation. Navigators and travellers in former days, and with them philosophers at the present moment, have accumulated their various observations; and from these data have been constructed magnetic charts, which should present, at one view, the declination of the needle for all parts of the globe."

These charts are of the highest interest, and may easily be procured; and it is to be hoped, that the local variations there indicated will be traced to their true source, to those other laws which as yet are unknown, but which I trust my new theory of the interior electric organization of the earth will help, if not be the means, to unfold.

That the electric state of the earth, and not that of the air, is the cause of the variation of the magnetic needle, is proved also by Cassini, who observed the diurnal variation at Paris, and who found, that neither the solar heat, nor light, influenced it; for it was the same in the deep caves constructed under the Observatory in Paris, where a sensibly constant temperature is preserved, and from which light is excluded at the surface. But the solar heat influences the electric condition of the earth, and this influences the motion of the magnetic needle.

In the absence of thunderstorms, sand, land, and water-spouts, and the aurora borealis, positive electricity in the air is not sufficiently concentrated to affect the magnetic needle, unmistakingly attracted by the more condensed or concentrated element within the interior of the earth; and nothing points out to us this fact more clearly than the very *dip* of the needle.

The discoverer of the *dip* (quoting from Dr. Lardner)

found that at London a magnetic needle, free to move on an axis perpendicular to the magnetic meridian, presented its north pole downwards, forming an angle of above  $71^{\circ}$ . If the instrument be carried northward, it is found that the dip generally increases; and on reaching a certain region near the pole, the needle would become vertical, the dip being then  $90^{\circ}$ , and its north pole pointing downwards. At such a place the common compass-needle, moving on a vertical support, would lose its directive power, and rest indifferently in any position. A place where these effects would be produced is called a *Northern Magnetic Pole*.

If, on the other hand, the dipping-needle were carried to the equator, the magnitude of the *dip* would be gradually diminished, until, on arriving at a certain region near the equator, the needle would become horizontal, and the dip would become nothing; and if the dipping-needle could be carried round the globe, always following such a course as would allow it to retain its horizontal position, its course traced on the globe would be the *Magnetic Equator*.

The magnetic equator does not coincide with the equator of the globe, nor is it a great circle of the earth. It never departs from the equator, however, more than twelve or thirteen degrees; all which agrees with my theory.

If, after passing the magnetic equator, the dipping-needle be carried southwards, its south pole will dip, or be directed downwards; and this dip will increase in magnitude as the needle approaches the south pole. A place near that pole where the needle becomes vertical, is a *Southern Magnetic Pole*.

The dip also, like the variation of the needle and the intensity of the electricity of the earth, is subject to variation according to place, time, and local causes.

To account for the phenomena of terrestrial magnetism,

Oersted proposes the hypothesis of currents of electricity circulating round the terrestrial globe, from east to west, in planes at right angles to the direction of the dipping-needle ; but it is evident that such currents floating on the earth and surrounding or immersing the needle, could not have the described effect either upon its variation or its dip. These currents, then, do not exist besides the electric tide I have spoken of, besides those superior electric currents from the poles to the equator, and their general deflection westward round the globe in proportion to their nearing the equator, owing to the revolution of the earth in the opposite direction. The magnetic needle too significantly points to the poles and to the interior of the earth to allow of one moment's doubt as to the interior electric organization of our globe.

If there is, as I believe, any current that produces the dip of the needle, that current exists within the interior of the earth ; and as a wire, along which an electric current is passed, will have a tendency to turn a magnetic needle at right angles to it : so that interior electric current, according to its intensity, attracts and produces the dip of the magnetic needle.

One of the greatest evidences of this subterranean agency is supplied to us by Von Hoff. In the Report of the British Association for 1850, he says : "More remarkable, however, are the changes in the direction of the dip-and-variation needles, which take place (not only in the vicinity of volcanoes as we have seen by Professor Palmieri's report,—see page 65, but) *at a distance* from the place where the earthquake was observed, and at a place where the shock itself is not perceptible ; as, for instance, in Paris, on the 19th February and 31st May, 1822, simultaneously with an earthquake which occurred in Savoy and some of the southern parts of France. If this observation should be established by others carefully made, the existence

could not be denied of a connection between terrestrial vulcanism and terrestrial magnetism."

It has been noticed, that severe earthquakes and volcanic eruptions have followed upon severe winters. M. de Tschihatcoff relates, that on the 16th February, 1755, the Golden Horn of Constantinople was covered with a sheet of ice which bore foot-passengers. Upon this followed the memorable earthquake of 1st November, 1755, as upon the strong winter of the beginning of 1855 followed the eruption of Vesuvius; in May, the earthquakes at Broussa and in the western parts of Europe. The rigorous winter of 1669 was followed by one of the most remarkable eruptions of Etna.

These severe winters shut up the evaporation of the electricity of the earth and keep it pent up, when afterwards it finds vent again by sudden shocks and by volcanic eruptions of more than ordinary violence.

Besides these proofs of an interior electric inflation, or constitution and organization, of the earth, we have still to call to witness a certain species of iron ore, or oxide of iron, abundantly found at Roslagen, in Sweden. On being taken from the mine (see Lardner) where it has lain for ages exposed to the influence of the earth's magnetism, it is itself found endowed with permanent magnetic power. It is, in fact, the loadstone. But this magnetism of the earth is its interior electric element, the current coursing through the various strata of the earth, and causing more or less all the phenomena I have just recorded.\*

\* Travelling in some of the mining districts in Germany, I have often expressed my belief to gentlemen interested in mining, as well as in science, the same as I have done to various friends in England, that the time would come when certain electric phenomena would guide us in finding out the mineral wealth buried in the earth. It often

But this interior electric organization of the earth leads us to greater results, even to the cause of revolution of our globe round its own axis.

"Let us," in the words of Dr. Lardner, "consider the case of the attraction or repulsion which is apparently exerted by an electrified body, S, on a non-conducting body, S', also electrified.

"In this case, the electric fluid on S attracts or repels the electric fluid on S'. Now since the pressure of the surrounding air prevents any motion of the fluid in a direction perpendicular to the surface of S', and the non-conducting power forbids any superficial motion of the particles of fluid, no change of position *inter se* can ensue, and the shell of the electric fluid will preserve its form exactly as if it were solid matter encrusting the body S'. The attraction or repulsion of the fluid on S must, therefore, cause a motion of the entire shell of fluid on S', to or from the body S; and as this pre-

struck me, that some valleys and hills in the same district, in the same neighbourhood, and in similar direction, very differently remained covered with fogs, whilst others were quite free from them; and I could not help but ascribing this to the interior condition of the respective areas. All at once, in reading the Journal of Mayence (*Mainzer Journal*) of 18th October, 1857, I find both my new theory and my supposition respecting the discovery of metalliferous spots of the earth, confirmed by the following article:—

"These many years already it had been observed, that at the time of heavy thunderstorms, the lightning always struck into the so-called Katzenberg (cat's-mountain), in the Gemarkung (district) of Volkartshain, in the grand-duchy of Hesse, though several still higher mountains lie around it. Attention being directed to the attraction of this mountain, search was made a few weeks since, and ironstone discovered. The quality is said to be an excellent one."

If nature points out the way, science will not neglect to follow it up; it will devise instruments to notice electric exhalations, and so fix upon the coveted deposits within the earth.

servation of the form of the electric shell necessarily requires the continuance of the body which it invests within it, that body must accompany it as it moves to or from the body S.

"This may be illustrated in the following manner. Let us suppose a sphere of cork to have its surface covered by iron dust, and imagine this dust to be pressed against the surface of the cork by a surrounding atmosphere, whose pressure is sufficient to prevent its escape from the surface. Also suppose that the roughness of the surface of the cork is sufficient to prevent the particles of iron from moving upon it. Let this sphere be placed near a powerful magnet. The iron will be strongly attracted, and if free, would leave the cork and fly to the magnet. But this is prevented by the causes just stated. The iron can neither leave the cork, nor shift its position upon it. It must, therefore, move towards the magnet in virtue of the attraction exerted on it, carrying the sphere of cork which it invests, along with it."

Now, for the sphere of cork, substitute our globe; for the iron dust, the loadstone, minerals and coal-fields of the earth, and in place of a powerful magnet, let us put the all-powerful magnet of the sun, and the cause of rotation of our earth, riding within the solar atmosphere, is explained.

But this explanation I nevertheless do not think the correct one. I think it more probable, from all I have advanced, that the electric fluid within the earth, attracted and kept in circulation by the heat of the sun, causing the variation and dip of the needle, and iron to be magnetized within the bowels of the earth, is the true cause of the revolution of our globe round its own axis, the cause of Sir Isaac Newton's supposed centrifugal, as well as centripetal, force, that holds the masses of the earth together.

As the blood of the human body flows in a prescribed

direction, so God ordained, that the electric circulation of the sun and planets should proceed from west to east. The sun shining with intense heat upon the earth, thus causes the electric current to take its course round the most excited part, the belt of the equator, in the direction in which the revolving sun, as it were, precedes the earth; and the heating of one half of the earth taking place without intermission, the electric current from the cold part, to that which is warmed and expanded, flows without ceasing; but having to overcome the resisting masses of the earth within which it moves, and its power being more particularly exerted within the outer circle, within the tire, the crust of the earth, is capable of turning it round its own axis; and thus, moved by the spiral spring of negative electricity, the earth has become the divine chronometer of mankind.

When, in the foreknowledge of the faith of Joshua, God, the Father of His chosen people, applied the break of His omnipotence to the current of electricity that turns our globe, and by these means slackened the pace of its revolution, He performed that miracle which the Israelites beheld in the apparent standing still of the sun and moon, and by which the prayer and faith of the Jewish leader was rewarded. God, as He often does, did not indeed literally fulfil the request of Joshua, but granted, by an equivalent, as it were, what in His service he demanded.

The girdle of the earth, shone upon by the sun at noon, presents to us the negative, and at the opposite or midnight part, the positive side of the electric equator, whilst the earth itself appears like a magnetic needle in an horizontal position, with its electric poles north and south, revolving from west to east within the atmosphere of the sun, the same as all the other planets with their respective poles, revolving likewise in this direction, according to their electric inflation or con-

stitution, the construction or density of their masses, or the circumference of their bodies.

The sun himself (and fixed stars), no doubt, revolves on his horizontal axis from the same cause which turns our globe. By most scientific men, I may say by almost all, his body is considered to consist of solid matter like our own earth, and to be surrounded by a luminous atmosphere. Dr. Elliott, as early as 1787, maintained, "that the light of the sun proceeds from a dense and universal aurora which may afford ample light to the inhabitants of the surface beneath, and yet be at such a distance aloft, as not to annoy them." And Sir David Brewster, in his "More Worlds than One," remarks: "Sometimes by the naked eye, but frequently even by small telescopes, large black spots, many thousand miles in diameter, are seen upon its surface, and are evidently openings in the luminous atmosphere, through which we see the opaque solid nucleus, or the real body of the sun."

This confirms my new theory of accumulation of positive electricity round the heavenly bodies, of which suns are the largest.

When a magnetic needle, sufficiently light, is placed within a helix or screw of wire, so as to rest on the lower part of the wire, it will start up and place itself in the centre and remain there suspended in the air without any visible support, and against the law of gravitation, as soon as a powerful current of electricity is passed along the thread of the helix.

Like a magnetic needle within a helical current, the sun is surrounded by, and kept in suspense within, an accumulation of positive electricity, constantly in motion and action.

As the amalgamation of positive and negative electricity with us, in the phenomena of the various descriptions of lightning, and of the aurora borealis, which has been

observed to continue sometimes for two days, take place in the upper parts of our atmosphere, so the amalgamation of the positive electricity collected and collecting round the sun, with the negative electricity with which he is inflated, takes place at a corresponding distance from the opaque body of the sun; and this constant amalgamation and consequent production of electric light and heat,—not for days, but incessantly bursting forth, perhaps from a segment, an aggregation of matter, similar to that from which the aurora borealis is mostly evolved or developed,—acts upon his interior electric organization, the same as it does upon that of our earth.

It may be objected that this result cannot be effected as regards the body of the sun, since he is totally surrounded by this electric fire-ring, every part of which neutralizing the other, and keeping the body of the sun, supposing him to have no other momentum, in a state of repose. But it must not be forgotten, that there are openings, *many thousand miles in diameter*, in this electric fire-ring, which, breaking the contact, render its effect unequal on the different parts of the body of the sun.

In certain parts of our globe neither lightning, nor thunder, is ever witnessed; and it appears from this, that in these places there is no proper medium for the union of the two electricities in the air.

Humboldt says, “that in the geographical distribution of thunderstorms, the Peruvian coast-land offers the most striking contrast to the whole of the other parts of the tropics; that, whilst in these, at certain times of the year, thunderstorms are formed every day, from four to five hours after the culmination of the sun, in the former it never lightens or thunders.”

This may, no doubt, be accounted for by the fact, that the

coast-land of Peru is mostly arid, and covered with sands and deserts; and though it possesses many valleys, conductors in the shape of forests, or otherwise, may not be sufficiently numerous to admit of an accumulation of negative electricity in the superior atmosphere, large enough to attract the positive electricity above, whether free or harboured by clouds. Deserts, or even sandy districts, from want of moisture and of vegetation, or other causes, may not emit or exhale perhaps the negative element in that abundance which we witness in cultivated and highly-productive soil; and that which is so emitted has no conductors to carry it upwards. It may be also, though it seems to me less likely, that the mountain-chain of the Andes, running parallel with the coast, and at no very great distance from it, down to Chili, is so powerful a conductor, as to attract the electricity emanating from the coast-land as soon as it has been liberated from the earth. In either case, however, there are no two electricities to come in contact in the atmosphere in such a manner as will produce lightning or thunder.

If, therefore, the body of the sun, like the body of the earth, as is most probable, has his deserts of Peru and Chili, of Africa and Asia, his vast oceans of water, where, according to the distance from land, it rarely or never lightens or thunders; where the isolated sand, land, and waterspout, the cradle of whirlwinds, perform the office of uniting in destructive embrace the two opposite electricities, instead of the scarcely less awful but more sublime thundercloud, the magnificent aurora borealis, and the silent lightning-discharge of our summer evenings: the black spots, however vast in extent, and naturally varying in size from time to time, will then have been explained; they break the contact of the two electricities, the veil of fire is perforated, its effect becomes unequal over the body of the sun, and the motion

of the fiery cloud, and the rotation of the sun round his own axis, are a necessary consequence of the attraction of positive and negative electricity, their amalgamation and production of light.

The production of the solar light, if more analogous to the aurora borealis than to lightning, would lead us to suppose, that vast regions of his body must be very cold, as with us the aurora borealis is produced only in the cold regions of the earth. Whether these regions alternate with cold and warm, as they do on our globe, will also depend on the interior electric organization and the oscillation of the sun himself. And is it not possible, nay, most probable, that these very cold regions, apart from attraction and repulsion, act upon, or are acted upon, by comets, as on their mighty sweep through the solar system, they approach the great orb of the day, lighting up his unilluminated spaces, and in his presence appear to us with increased splendour and light?

The periodical appearance and disappearance of the Mira Stella, and of about twenty other fixed stars that are said to have been observed, is, no doubt, based upon a constitution of its body, similar to that of the sun; the one side is so vast and barren, or covered with water, that no light is produced upon it, or a light so feeble or partial, that to us it remains imperceptible. And yet the organization, like that of the sun, must be such, that, by means of its own fiery envelope, the body rotates upon its own axis, becoming invisible to us as by degrees the lightless spot is presented to us, and visible as by degrees the illuminated side returns again before our eyes.

The sun, then, by means of the black spots, the openings in his veil of fire, revolving round his own oscillating horizontal axis in one direction, the planets revolving round their own horizontal axes in the same direction round and above the

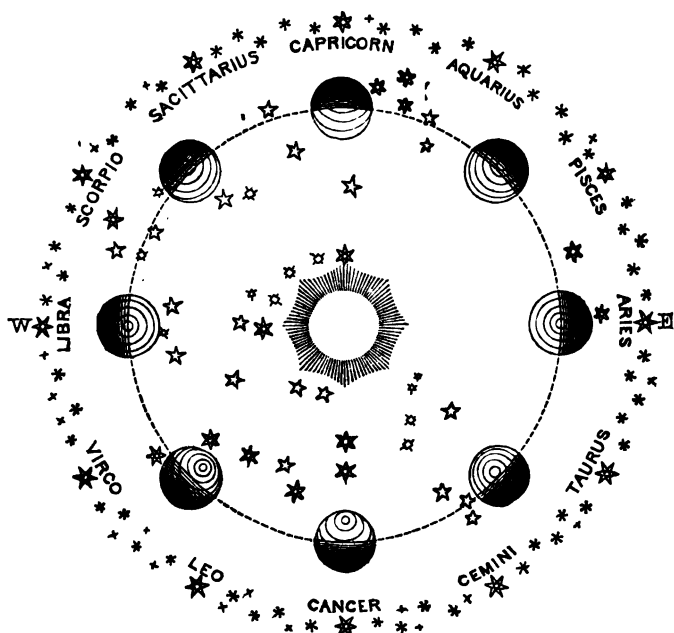
equator of the sun, and the equatorial belt of the sun acting upon those of the planets, it follows: that the axes of all these bodies, supposing their time of the equinox happening all at the same moment, should be parallel to each other, and revolve in one line and direction; and the whole of our solar system should present to us one north and one south pole in regard to the centre of the whole universe, the same as the earth does to the sun, unless our own system be the centre of creation itself.

With the notion of rotation we naturally associate the idea of progression in the same direction in which the rotation itself takes place; and if thus we consider the planets, with their axes parallel to that of the sun, we cannot but see that, as a matter of course, they ought to revolve round the sun, as a balloon would round the earth, if in its construction we could but give it rotary motion round its horizontal axis.

But if this were so, it may be objected, we should not be able to account for the four seasons; on this principle every part of a planet would always have the same season without any variation, inasmuch as in the case in question the sun would shine equally upon every respective part the whole year round. And yet, my proposition is true after all, and the difficulty of the season easily solved when we bear in mind the interior electric organization of the earth, with its two magnetic poles, and its magnetic or electric centre. The same as the centre, the heart, of the earth is acted upon by the sun, so are the poles, and this in such manner, that the balance of the spiral circulation of the electric fluid in the earth, inclining by degrees for six months to the north, the sun will attract the north pole and repel the south, and inclining for the other six months to the south, he will attract the south and repel the north pole, or, which is the same, the balance of circulation will cause the poles to rise and fall

in turn, held, as it were, by the beam of the sun. By this gradual inclination, produced by the sun, as he apparently passes through the ecliptic, the earth will undergo but two oscillations\* a year, shifting, in a manner, the equator in an oblique direction north and south.

When, as in the following diagram, facing the south pole of the earth, and looking in the distance at the fixed stars of



the northern heaven, the same as at page 1, facing the south poles of all our planets, the reader sees the earth in the sign

\* If, in their course round the sun, the superior planets, Jupiter, Saturn, and the rest, undergo but two oscillations during the period of one entire revolution, a change of seasons would require 12 of our years in the case of Jupiter, 29 $\frac{1}{2}$  in the case of Saturn, 84 in that of Uranus,

of Libra, its axis is presented horizontally to the sun, one half of its surface is shone upon by him from pole to pole, we have the vernal equinox, our day and night are equal, we have spring. As the earth on its path advances to Scorpio and Sagittarius, the south pole is repelled by the sun, and by degrees passes into the shade, until, arrived at Capricorn, the repulsion is complete, and it then is, to a considerable distance, altogether enveloped in darkness, making it cold, winter, and short days there, whilst the north pole, attracted, and to a corresponding distance completely exposed to the light of the sun, we have it warm, have long days, and our summer here. Proceeding towards Aquarius and Pisces, the north pole is repelled by the sun, and the south pole attracted, the former pushed back or away from, and the latter drawn towards the light, until, arrived at Aries, the axis of the earth has assumed the horizontal position it had in Libra; the earth again is shone upon from pole to pole, we have the autumnal equinox, our day and night are equal, we have autumn. Passing on to Taurus and Gemini, the north pole is further repelled from, and the south pole more attracted into, the light of the sun, until, arrived at Cancer, the north pole to a considerable distance is completely enveloped in darkness, and the south pole, to the same corresponding distance, completely exposed to the sun; there is winter with its short days here, summer with its long days there. Progressing towards Leo and Virgo, the south pole is repelled and the north pole attracted, until spring dawns upon us again on our return to Libra.

By this oscillating motion the obliquity of the ecliptic is

and 164 in the case of Neptune; everything thereon must, therefore, be very different from what it is here, and the idea of their being peopled with a *living creation similar to ours*, can certainly not be entertained.

established, and not only are the four seasons accounted for in a far more simple, natural, and rational manner than they or the former have hitherto been explained, but the key even has been found for the diversities of the various seasons in different years, depending upon the greater or lesser oscillation of our globe, caused by the oscillation of the sun himself, and upon the periodical variation in the extent, density, and intensity of the solar fire-veil.

Of what are the nature and duration of the oscillations of the sun must be left to learned astronomers to find out; but the undecennial or eleven-yearly variation in the solar fire-veil arises no doubt from this, that, like the water of the earth, it is left behind in the rotation of the solid, or opaque, body, round its own axis, the same also as the moon is left behind in the rotation of our planet. And this difference of rotation between the fire-veil of the sun and his opaque body, both meeting again after about every ten or rather eleven years in the same relative position in which, or under the same points or constellation of the heavens, under and from which they parted, forms a cycle like that of the moon and the earth (and the moons and rings of the planets with their primaries) in their united yet different speed of rotation. And this gradual shifting of the solar fire-veil above the opaque body of the sun, both imperceptibly changing their mutual action and reaction, and influencing their own condition: the intensity of the fire-veil, and the extent of the solar spots, must naturally be productive of a periodical change in the temperature and condition of the earth.

Comets and planets may indirectly, if not directly, affect the condition of the earth, though the primary cause must again be sought in the sun.

When a comet appears in sight, on its approach to the sun, it is powerfully attracted by him, and this attraction

increases with the increase of proximity. By this means the body of the sun becomes more than ordinarily excited; this excitement, in proportion to the cometic influence, determines a corresponding intensity, or other change, in the quantity and quality of his luminosity, in the quantity and quality of his rays; and this operates a change in the climatic condition of the earth, particularly when comets are large, and in their passage closely pass us by, and most nearly approach the sun.

Comets and planets, attracted by, and moving round the centre of the sun, are attached to him by electric links, which obediently they follow. If, then, it happens, that we are in conjunction with a comet or a planet, the earth with its electric link will be enveloped or embraced also by the electric link passing from the comet, or planet, to the sun; and hence the electric condition of our earth will thereby materially be affected, being exposed to a double attracting power, emanating from the sun both upon itself and upon the comet or planet; the effect will be different, again, whenever a comet or planet places itself in conjunction between us and the sun. Hence, also, the disturbing influence of the sun upon a planet in conjunction with another, or with a comet. And that these electric influences, of which comets and planets are the mediate cause, must more or less affect the electric state of the earth, and produce a different state of fecundity in vegetable life, as they may also act upon minds whose bodies are predisposed to electrical affection, at the right time and at the right place, for good or for bad in the good or the wicked, for health or disease, seems to me but very reasonable to believe, and warranted by almost universal opinion and tradition, if not experience, among all nations. And we ourselves, in the train of a most splendid comet, have witnessed the blessings of an over-abundant and luxurious yield of corn and wine; we have, however, seen also the seed of

sedition and treason, sown by the enemy and deceiver of mankind from the beginning, fostered and quickened, and the egg of a foul and pretended liberty, of premeditated revolution, hastened in its development, and hatched before the calculated time; and we now behold, in the horrors of war let loose against a peaceful state, in the destruction of that peace, about which there is something so beautiful in families and nations, the abundant harvest of Satan gathered in by his servants.

If the upper surface of thunderclouds, as noticed at page 61, presents to us ridges and protuberances rising upwards to great altitudes, and if the aurora borealis (page 50) sends up lofty cones and streaks of light: it seems to me most probable, that at times, more or less, such protuberances and mountainous elevations should happen, or be produced, on the superior surface of the solar fire-veil, particularly round the equator, where the electric element is most active, manifesting itself in the zodiacal light and other appearances in the envelope of our luminary; but, whether in that state the sun differently influences the climate and productive condition of the earth, remains still to be found out. As, however, the zodiacal light, like a faint luminous cone, is said to extend beyond the orbits of Mercury and Venus, and even to rise nearly to the orbit of the earth, it is more likely than not, that the sun at the time, or during the period of its appearance, should differently affect the electric condition and consequent productiveness of our planet.

According to the present theory, the earth, like all the planets, has arbitrarily been assumed to rotate round its *upright* axis, giving to the axis an inclination from the perpendicular to the plane of her orbit of about twenty-three degrees, and to the other planets more or less; and this is what constitutes the obliquity of the ecliptic.

The earth, then, like a spinning-top, in the most arbitrary

manner, is made to dance forward, sideways, backward, sideways, and forward again in a circle round the sun, with its head, or north pole, always pointing to the same constellation, to the same part of the heavens, whilst it constantly rotates at angles, and at one time even in exactly the opposite direction, with the line of pro- or retro-gression, except in one instance, where rotation coincides with its path. The theory reminds me of the boy coming too late to school on a fine slippery winter morning. When asked the reason of his being behind time, he said, that when he made one step forward, he slipped two backward; and on being required to explain how by that means he came to school at all, he replied, that he began to go home. Thus the earth is made to rotate one way, and to progress the other in its stooping position.

There might be still *some* reason for this, if the south pole, the pivot of the earth's rotation, were resting and moving forward on a solid or hard substance, like the spinning-top on the table or floor. The friction of the pivot of the spinning-top is with the wood or the ground upon which it dances, and, of course, much greater than the friction of the body itself with the air in which it turns round. If it were the same with the earth, that the pivot, the point of its south pole, were resting and spinning round upon a solid body or foundation; that the south pole were attracted by and pointing to a body, to a centre of gravitation underneath, the same as the pivot of the spinning-top; as a balloon twisted or turned round its perpendicular axis in the air, and whose lower part, or the car, is pointing to and attracted by the centre of the earth as the fulcrum of gravitation of the whole body, there would be no anomaly in the old theory; but the earth moves within a fluid which everywhere presses equally upon it; friction, therefore, can take place on that part of

the surface only which rotates or turns over; and this part being the equatorial belt of the earth, that part through which, from its centre to the *centre* of the sun, passes the line of attraction or gravitation,—not through south or north pole,—it follows : that our globe rotates one way, and progresses in another, and this all the more so, when we consider that the earth is said to stoop forward, that its north pole is inclined twenty-three and a half degrees to the plane of its path, and on which plane there is no support or friction.

But more. If the theory of gravitation be true, the revolution of the earth round the sun becomes still more arbitrary and inexplicable.

The earth, *assumed* to be projected by the Creator in a straight line, is said to be drawn out of it by the attraction of the sun, and these two forces, projectile and attractive, draw and keep it in its orbit.

Now if this were true, the earth would move round the sun as a bird would fly round the earth, head always foremost, and in advance of the body, because the same forces which are said to make the earth move in a circular or elliptic orbit round the sun, would also influence the position of the body of the earth itself, and throw it into a diagonal direction between the said two forces ; the direction or inclination of the earth, as it was flung into space by the Almighty, would always coincide with the line or direction of its path or orbit, whereas, to sustain the fact of its north pole always pointing to the polar star, without the assistance of any given third power, it is on its passage made to go six months in advance with the north, and, by a gradual change, unexplained and inexplicable, six months in advance with the south pole, or, which is the same, six months foremost with the head, and six months foremost with the tail, including the sideward motion, or pro- and retro-gression, right and left.

By what law, except the most arbitrary, however ingenious the invention, should the earth at one time present head, and at another, tail, and at others, again, front or side, to the sun ?

If a straight line of railway of twenty or thirty miles in length were changed into a circle or an ellipse, and carried round London, so that end met end, the engine would always be in advance of the train, whether it travelled on the line when straight or when changed into a circle.

The same with the earth. If not attracted by the sun, it is said, it would have travelled in a straight line to the Polar Star regions, stooping with its north pole, its hoary head, as it were, in advance ; but since that line was changed into a curve round the sun, why should the north pole not be in advance on the curved line, the same as it was on the straight one ? Why should, on one side of the sun, the feet, the south pole, be in advance ? Is there a third force keeping it by the hair, attracting it to the Polar Star regions, making the train turn on a pivot once on the line round London, so as to keep the engine always working in the direction of the northern Scotland, or the polar star, whilst it completes the circuit of the City ?

It is contended, that the composition of the two forces which turn the straight part of the earth into a circular or elliptical one, does not influence the body of the earth itself, because these two forces act upon the centre, upon a point, and that we can well imagine in this way the earth to preserve its parallelism during its passage round the sun. True, we may imagine and believe such a thing, because to God everything is possible ; but it is nevertheless a great fallacy, and *does not correspond to the law laid down.*

A point, a centre, is either nothing, or something ; if it is nothing, no power or composition of powers can affect it ; if it is something, it must be something substantial, something

tangible; and if it be substantial or tangible, the composition of the two forces must affect it, whether the point is beyond imagination little, or beyond conception grand. To God, the whole creation is but a point in eternity; the suns, the planets; the moons: all are but enlarged points, and as such must be subject to the action of forces exercised upon them, not merely as regards their path, but also their corporal position or situation. If the *centres of bodies, imaginary points* without substance, are alone affected by the forces of attraction and gravitation, it seems to me strange that the centre of gravitation of the planets should be laid exterior to the centre of the sun, and that that of the moon should be placed outside the earth. But let us exemplify the fallacy of the old theory.

A substantial point or ball being the same, whether large or small, let us suppose such a ball within the grasp of the two reputed forces, the dotted line,  $p$  (fig. 1), representing the projectile force coming from the hands of the Almighty, and

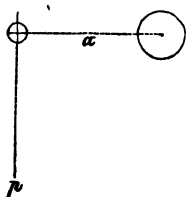


Fig. 1.

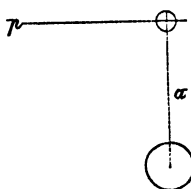


Fig. 2.

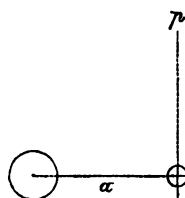


Fig. 3.

the dotted line,  $a$ , representing the attractive force emanating from the centre of the sun. In this position (fig. 1) the point of such ball would be directed to the top of the page. The projectile force,  $p$ , does not allow the ball any rest, and the attracting force from the centre of the sun, *not from any spot exterior to this centre*, does not relax its hold; and thus

the body of the ball must retain its relative position and inclination to the sun. On its onward path, this relative position would have been preserved, the point of the ball would have changed its original direction from the top of the page to the right hand (fig. 2) of the same; and further on, the same two forces driving and drawing the object of contention with untiring and unyielding might, the point of the ball is directed (fig. 3) to the bottom of the page, and so on, the same as the railway train would travel round a town, point or engine always in advance. Let us invest the ball, the heavenly bodies, with four cardinal points culminating in the centre; let the propelling and attracting powers lay hold of two such points: and will it be said that in the course of a revolution of the ball these forces shift or remove their hold from one cardinal point to the other, that the two forces, acting always in the same direction, will twist the ball, as between two fingers, in a contrary direction from that of its path? that the ball will be the sport as well as the slave of the two forces? Or is it really possible still, according to *the law* of the composition of the two forces in question, that a substantial point, a ball, the earth, the train, moving in a circle on a plane, can, or could, preserve their parallelism under the influence of these forces? Imagine these bodies in the following position:—

Propelled by the hand of the Almighty, in imagination, by electricity, steam, or otherwise, they come up in straight lines, perhaps in a succession of bodies: what in the world, except a third, unexplained power, a mystery, could make them, as in fig. 2, preserve their original direction, their parallelism, their north pole,  $N P$ , or foremost part, always pointing to the top of the page? Whilst on the straight line engine follows engine, globe follows globe, we find them on the northern curve side by side, the wheels of the engine

rotating forward towards the Polar Star regions, and yet the engine going sideward on its plane; on the eastern curve we find them again following one another, but backward, the engine-wheels positively going in the direction opposite to

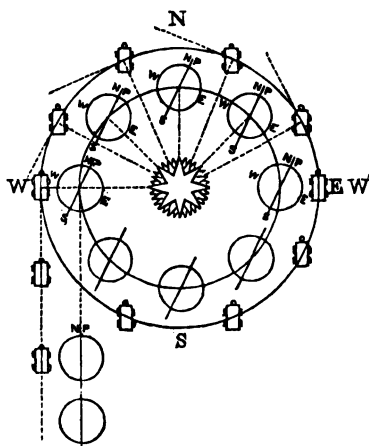


Fig. 2. As it is by *assumption*.

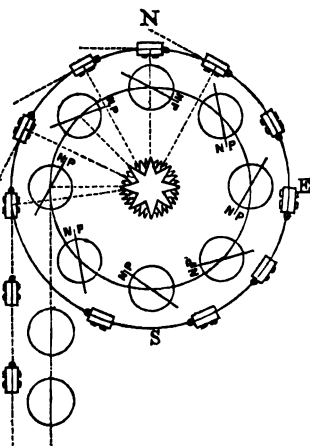


Fig. 3. As it ought to be by *law*.

that of their rotation; and on the southern curve we find them again side by side, rotating at angles with the line of progression, and the globes rotating one way, and going in the opposite. The planets, thus said to spin round the sun on an horizontal plane, whether in a resisting medium or in an alleged vacant space, in this manner, like the engines and globes above, on the theory of the day, move on a false bottom, on an airy foundation, on an imaginary plane, held in suspense by a fictitious lever, centred on a *shifting phantom fulcrum* outside or exterior to the centre of the sun; and the calculation of their weight against the weight of the sun, and the consequent calculation of their fulcrum, their point of gravitation as existing somewhere between the centre and the

surface of the sun, is every day disturbed and falsified by the discovery of new planets, whilst it will make no difference in my theory, whatever number of planets may still be discovered, whatever their weight, size, and distance, because all find their point of rest in the solar centre ; and considering each curve the orbit of a planet, and these planets and the sun, in their relation to each other, drawn towards each other, and yet kept apart by a mutual attraction and mutual repulsion : this mutual attraction and repulsion becomes neutralization, and a neutral state in physics means a state in which the balance of powers is equal—*it means nothing*.

This theory is stated and commented upon by Mr. Mackintosh in his "Electrical Theory of the Universe," in the following manner. Speaking of Sir Isaac Newton's centrifugal force, he says : "This is the weak point of the Newtonian philosophy, for very little reflection will enable us to discern that the momentum or centrifugal *force*, as it is absurdly denominated, is no force whatever, but an *effect* derived from, and dependent upon a real force, whatever that force may be. The Creator, it is said, having formed the earth and moon, impelled them from his hand into space, somewhat after the manner that a man impels a cricket or skittle ball, by which *primitive impulse*, as it is technically termed, a momentum was created ; and space being a vacuum, it is said this momentum once created, must remain undiminished for ever, because a body once put in motion, must continue in motion, unless it meet with some resistance from another body to destroy that motion ; and further, under the influence of this momentum, as derived from the 'primitive impulse ;' the earth or moving body, continually endeavours to proceed in a straight line, and would so move, and be thereby carried out of the solar system, were it not that she is continually deflected from this course, and turned towards

the sun by the force of attraction. Again, as the earth revolves upon her axis, it is said, that at the time of her receiving the 'primitive impulse,' she was held, not exactly in the centre, but a little on one side, so that, when she received the great heave, she went off with a whirling motion, which she has retained ever since, just as a stick, held by one end, whirls, when thrown from the hand, with this difference, that the stick does not whirl for ever. It will scarcely be believed that Laplace, '*Laplace le grand*,' actually entered into an elaborate calculation, with a view to determine at what particular point the Creator held the earth at the time of giving the grand push, and that after a most profound investigation, he arrived at the never-to-be-forgotten conclusion, that when the 'primitive impulse' was imparted, the earth was held exactly twenty-five miles from the centre, and hence, quoth Laplace, the earth revolves upon her axis once in twenty-four hours. If she had been held a little nearer to the centre, our days would have been longer, and if a little farther off, she would have revolved with greater velocity, and our days would have been shorter. . . . . These assumptions comprehend the very essence of what is called the Newtonian philosophy, and the world has been gravely assured that every proposition has been rigidly demonstrated."

This even is not all. In order to give basis to his invention, Newton was obliged to assume, and the world has unhesitatingly believed him, that the heavenly bodies move in *vacant space*! That there is a *vacant creation*! And yet many of those who believe in this vacant space, cannot believe in vacant space outside the ball of creation, cannot believe that the exterior of creation is filled by God alone from eternity to eternity. But, allow a substance ever so fine to pervade the universe, and the foundation of the old

theory is removed, and the whole edifice crumbles to pieces. And that an invisible ether fills all creation is now not only believed by the many as a matter of course, but has also been demonstrated by eminent men.

After this, the old theory of the rotation of the earth round its own axis, and in its orbit round the sun, must strike every one still more as arbitrary, forced, unnatural and untenable, whilst my own propositions could not be more simple and reasonable, though no doubt, not without some flaw or other. And if on the old theory astronomical calculations hitherto have proved pretty correct, it is because my new theory very little disturbs the present arbitrary adoption of the inclination of the ecliptic, the position of the earth in its annual course round the sun; for, if the axis of the earth, at the time of the equinox, were taken in the exact perpendicular instead of the incline of  $23\frac{1}{2}$  degrees to the plane of its orbit, the whole theory, in this respect, would exactly coincide with my own, according to which the oscillation of the earth in its rotary course round the sun, in a most simple manner, explains the so-called nutation of the earth's axis, whilst more evidently still it explains the circle which the north pole of the earth, in the course of the earth round the sun, is said to describe round the polar star; and the performing of this circle round the Polar Star is a *necessary consequence* of the path and motion of the earth, the same as its orbital course and oscillation brings us nearer to the polar star at one time than at the other.

My theory of rotary progression accounts also for the precession of the equinox, which seems to be nothing but a slight annual retardation of the earth in its path round the sun, so that the earth does not perform a complete revolution round the sun during its two oscillations in the year; or, the apparent retardation proves, that the whole of the

heavens are moving eastward round their common centre, our own solar system.

It has been supposed that the whole of the heavens turn round a fixed axis, the one end of which is placed above our horizon in the vicinity of the Polar Star. The reason given for this is, that the constellations around the Polar Star, the constellations of the Great Bear, Dragon, Cepheus, Cassiopeja, Capella, and the Little Bear, of which group the Polar Star forms the centre, perform a circular movement every day, without altering their respective positions to each other. This circular movement however, is only apparent. The constellations in question are sufficiently distant from us beyond the northern part of the earth, so as to be always visible to us; they form a circle in the heavens corresponding to the circle of the earth. When thus the earth revolves round its own axis, the spectator passes through, or describes, a circle in twenty-four hours; and during this time the constellations ranged in a similar circle at an inclination above him will in turn appear in the zenith and rise and fall towards the horizon, the same as the sun on the day he does not set to the observer in the polar regions. The Polar Star, being the centre of the above constellations, and at a much greater distance from us than they themselves, will naturally describe but a small apparent circle during the rotation of the earth in twenty-four hours. Thus, the circle described by the rotation of the earth makes it appear as if the vault of heaven were moving round a fixed axis having one of its ends near the Polar Star. But, as I have said before, it is more likely that the precession of the equinox indicates a universal movement of the heavens from west to east.

The elliptical orbit of the earth, as well as of all the planets, if not disproved, is at least accounted for by my theory.

When the moon is near the horizon, either rising or setting, she appears much larger, than when she is higher up. The sun likewise looks much larger in the morning and evening than at midday, when he is nearly above our heads. The reason of it is this: that when these bodies are (to us) high in the vault of heaven, their rays fall nearly in a perpendicular line upon the spot we live, without being refracted by the atmosphere; if, however, they are near the horizon, and consequently *further away from us*, though equally near to the earth at large, their rays are refracted by the atmosphere which they penetrate in a slanting manner, and therefore also to a greater depth or thickness, and hence they appear to us through a magnifying medium, although with diminished brightness.

The same must be the case when the earth is oscillating above the equator of the sun.

When in our summer the northern part of it is attracted, and the southern one repelled, the luminary of our system appears to us small, though *nearer* than in winter, because his rays are almost perpendicular to us; and in our winter he appears to us large, though we are repelled and the northern part of the globe retiring from him, because he has apparently receded into the horizon of Capricorn, his rays come to us obliquely through a greater depth or thickness of the refracting atmosphere. But throughout this oscillation of the earth, the sun probably is always equally near to it in its orbit in general.

Upon the very opposite assumption the theory of the ellipticity of the earth's orbit is founded. According to this the sun is said to be further off from us in summer than in winter, because he seems so much smaller, and in winter he is said to be so much nearer than in summer, because he looks so much larger.

This reasoning would be true, if the intervening atmosphere did not counteract, or rather reverse, the law, that, the more distant the object, the smaller its apparent diameter, and the nearer the object, the larger its diameter.

Now if the calculation of the distance of the earth from the sun, and the elliptical orbit of the earth round the sun, have no other foundation than the fact, that the sun appears to us smaller in summer than in winter; that the time between the vernal and autumnal equinox is about eight days longer than that between the autumnal and vernal equinox, and that therefore the sun is much further away from the earth in our summer than he is in winter, we may well doubt it after what has been said before, and according to which the earth is more likely to move always at the same, or nearly the same, relative distance from the sun.

As to the longer journey, or slower motion, of the earth between the vernal and autumnal equinox, than between the autumnal and vernal equinox, it does not follow that therefore the earth must be at a greater distance from the sun, that it has to sweep through a wider curve during the former period. I think it more probable, that the earth this side the equator, having more land, and therefore being more intensely electric than the south, and consequently more strongly attracted by the sun, it travels slower, that is, it makes less progress in its orbital motion, though the axial rotation remains the same when the sun attracts the northern, as when he does the southern hemisphere. It is like the paddle-wheel of a steamer; the rotation of the wheel remains the same, whether against or with the current, though the progressive motion is different. Or, like the wheels of the locomotive, which for want of sufficient friction with the rail do not make much progress, though the revolutions remain the same. It may be also that in our summer,

for the reason before stated, the envelope of our earth becomes more expanded than when the rays of the sun are upon, and absorbed by, the waters of the south of our globe, and that therefore the earth may ascend and float a little higher in the atmosphere of the sun than generally. We should thus have an expansion and contraction of the atmosphere of the earth which would bring it further from the sun in our summer and nearer to him in winter, as the old theory has it, though the expansion and contraction, unlike that of the hair of the comet, would not, perhaps, influence the distance from the sun in any perceptible degree. At all events, my new theory, in either case, seems to me to solve the problem of the ellipticity of the orbit of the earth round the sun, not proved, at least, by the difference of the apparent diameter of the disc of the sun in summer and winter according to the old theory.

It is natural that during the oscillations of the earth, the alternate attraction and repulsion of its poles, and the expansion and contraction of its envelope, perhaps influenced also by the oscillations of the sun, or by the passing planets of our system, it should not move in a straight, undeviating line round the sun, but at times pass a little more to the right, and at others more to the left; and hence, no doubt, what are called *periodic and secular inequalities*.

By my theory the mutual attraction and repulsion of the planets, though not on the law of universal gravitation, is clearly demonstrated; they affect each other when approximating in their passage round the sun, but they do not keep each other in their respective positions and orbits. My theory moreover, seems most beautifully to illustrate the passage of the moon round the earth, and assigns a probable reason for her course.

Having, perhaps, like a meteor, risen from the earth, as

the planets may have risen from the sun, but as a body without the electric inflation or constitution of the planets, she is deprived of rotary motion, and only floats upon our sphere like a vessel on the ocean. God launched her, so to speak, on our ethereal atmosphere, *that as a light to the earth*, in turn attracted and repelled she might pass from pole to pole, and shed her benignant rays on those portions of our globe in particular, which are least in the enjoyment of the light of the sun. And for this purpose the Creator of the world had constructed her in such a manner, that, arriving within the magnetic equatorial regions, where there is neither pointing nor dipping of the magnetic needle, her craters and mountains should prevent her turning over, and that they also should act as divinely-arranged rudders, to keep her always in the path that had been assigned to her.

Drifting across her ethereal ocean from south to north she passes slowly on to the ecliptic, to the equatorial region of the earth, gently carried eastward by the revolving motion of our globe, though still making for the north. On nearing the ecliptic, the middle of the ethereal current she has to cross, her speed increases, and the rapid revolution of the earth, in its greatest circumference, would carry her out of her course and whirl her round the equator, if the rudders of the divine Constructor did not keep her in her path; she hastens, as it were, to take her light to the north, and drifts slower again on passing out of the current of the ecliptic.

In this manner the moon passes round the earth from pole to pole, from one side of the south to the other side of the north, crossing her ocean like a steady ferry the river, without ever altering her course or position. Every succeeding passage she fails, like the earth in its orbit round the sun, to reach the exact point from which she started, until after about nineteen years she arrives again at the

starting-point; and this is called the retrogression of the line of nodes.

The motion of the moons of the other planets, as well as the rings and moons of Saturn,—whether his rings be solid like the moon, or an electric product like the fire-veil of the sun, or the aurora borealis—rests upon the same foundation; as the planet revolves, it carries them round on its ethereal ocean, on the same principle on which a ship moves slower than the current which bears her; or, the motion of the planet eastward exercises a more powerful influence on the moon than the westerly current of the planet's atmosphere.

The planets Uranus and Neptune seem, however, to form an exception; for it has been found, that all the satellites of Uranus, and according to the discovery of Mr. Hind, that of Neptune, move in the opposite direction, that is, from east to west; and hence it follows, that the upper atmospheres of these planets must have a westerly current so strong as to counteract, to overcome, the rotary influence from west to east of the planets themselves.

The same happens with the sun and the comets, of which many move from west to east and many from east to west in the solar atmosphere; those moving from east to west, or having a retrograde motion, belonging almost exclusively to those comets which travel to the furthest limits of our system, into regions beyond Neptune, the most distant of all our hitherto discovered planets. The westerly current, or flow, of the more remote parts or oceans of atmosphere of the sun becomes stronger the nearer we approach the confines of the system; and the westerly motion of these infinitely attenuated and elastic oceans of fluids or gases, overcomes the eastward attracting influence of the eastward revolving sun; or the comets, or moons, in question, have no ballast, they are too light, and therefore, as it were, carried

back by the superior stream or streams of the solar or planetary atmosphere. These moons and comets may also want a proper or necessary amount of electricity, so that in their passage from one part of the planet to the other, from one pole of the solar system to the other in almost every direction across the ecliptic, the attraction of the eastward rotating planet and orb is insufficient to draw them in their respective train, and thus, like empty or powerless ships, they are carried away by trifling currents and winds.

Comets, in their diversified, spiral, and cyclical course round the sun, are no doubt influenced, if not positively directed, in their motions, by the poles of the solar system and the sun himself, as they are also more numerous about the former than in any other region of the solar sphere, the same as the auroras are more abundant in the polar regions than in the temperate zones of the earth, whilst none have been observed at the equator; the same also as meteors, mostly from the polar hemispheres, take their course in the direction of the meridian: but to the polar attraction and repulsion of the solar system, and the consequent passage of these bodies from one solar ocean into the other,—elongating, as they plunge into a denser medium the more they approach the sun, their hair into tails of enormous size and often dividing them into parts of two or more tails,\* according to the resistance of the matter or the current they move in or come across—seems to be due, as already noticed before, the extra-

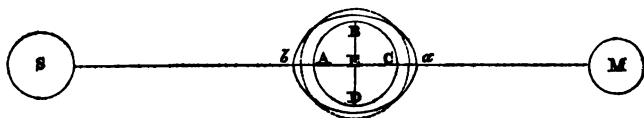
\* The tails are often of stupendous magnitude, varying from 5 to 200 millions of miles in length. But the brief period, in which they are often formed is no less amazing. The tail of the comet of 1843, which was long enough to reach from the sun to the planetoids, was formed in less than twenty days. The tails of comets are not always single; some have appeared with several tails. The comet of 1744 had six tails.—“*Worlds Beyond the Earth*,” p. 219.

ordinary eccentricity of their orbits, and the scarcity of their visits.

It has hitherto been supposed that the moons of Saturn, (as well as the sun and celestial objects) are carried parallel to the edges of the rings; but it is shown now, that by the apparent motion of the heavens, produced by the diurnal rotation of Saturn, they are moved so as to pass alternately from side to side of each of these edges, the same, and for the same reason, no doubt, as our moon alternately passes, attracted and repelled from pole to pole.

The tides are caused by the ship-like passage and *pressure* of the moon upon one of our oceans above; but the present, or Newtonian, theory of the tides, ascribes them to the *attraction* of the moon. In one of the most current works upon this subject we read, that "the tides are occasioned by the attraction of the sun and moon upon the waters of the earth.

"Let  $A B C D$  be supposed to be the earth, and  $E$  its centre: let the dotted circle represent a mass of water



covering the earth; let  $M$  be the moon in its orbit, and  $S$  the sun.

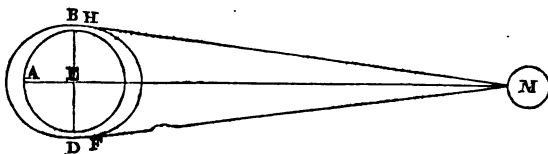
"Since the force of gravity, or attraction, diminishes, as the squares of the distance increase, the waters on the side of  $c$ , are more attracted by the moon  $M$ , than the central parts at  $E$ , and the central parts are more attracted than the waters at  $A$ ; consequently, the waters at  $a$  will recede from the centre; therefore, while the moon is in the situation  $M$ , the waters will rise towards  $a$  and  $b$  on the opposite sides of

the earth: that is, they will rise at *a* by the immediate attraction of the moon *M*, and will rise at *b* by the centre *E* receding, and leaving them more elevated there.

"The moon goes round the earth in an elliptical orbit, and therefore she approaches nearer to the earth in some parts of her orbit than in others. When she is nearest, the attraction is the strongest, and consequently it raises the tides most; and when she is farthest from the earth, her attraction is the least, and the tides the lowest."

In another work on "Natural Philosophy" we read that "the tides proceed from the attractive force of the sun and moon, which diminish the gravity of the waters of the ocean, or, which is the same thing, draw or lift up the waters towards themselves.

"The force of attraction acts in straight lines; and, therefore, if we draw two straight lines from the moon's centre, *M B*, *M D*, to represent this force, acting on the parts *B* and *D*,



it is obvious that the water at *B* and *D* will not be raised, but depressed, by being drawn away from *B* to *H*, and from *D* to *F*, and so of every part of the circle *B E D*. But the waters will, at the same time, rise on the side of the earth away from the moon, because the *earth's centre* being more strongly drawn *towards the moon* than the point *A*, recedes from *A*, which is the same in effect, as if the waters at *A* receded, or rose up from the earth's centre."

By the earth's rotation on its axis, the two tide-waves will be continually making their round over the ocean.

"The force of attraction acting in straight lines, it should be high water at any place in the *open sea* when the moon is upon the meridian of that place; but, in fact, the greatest (and least) heights of the water at such a place do not occur till about three hours after the periods fixed in this supposition. The delay is thus explained: the elevated parts of the sea have received such an impulse towards ascent, that they continue to rise after the earth's rotation has carried them from under the line of the direct attraction of the moon; this impulse being also aided for a time by the moon continuing to attract the water upwards, though in a less degree.

"The sun, though his attractive influence is three times less than that of the moon, acts upon the ocean in the same manner, though in a less degree. When these two bodies unite their influence, which they do at the seasons of new and full moon, the tides naturally rise the highest: they assist each other in raising the ocean as before described, and depressing it in a corresponding manner.

"Of the irregularities of the tides, caused by the continually-changing position of the sun and moon, those are the greatest which are occasioned by the obstacles offered by the land to the ebb and flow of the waters. The impediments created by shallows in the ocean, and by shores, bays, gulfs, and promontories of islands and continents are such, that the tides are greatly delayed, altered both in degree and direction, and in many places so accumulated, that they rise to heights far exceeding what is witnessed in the open ocean."

If, as Humboldt says, the tide-waves of the waters of the ocean, in the *open sea*, rise hardly to a *few feet*, they mount, in consequence of the configuration of the coasts, which oppose the coming tide, to 50 feet at St. Malo, and from 65 to 70 feet in the Bay of Fundy.

This is, as far as I have been able briefly to represent it, the present theory of the tides. Let us now consider its—

### ANOMALIES.

And here I cannot do better than have recourse to a work on the “Anomalies of the Tides,” by Thomas Kerigan, R.N., F.R.S. In his Address to the Reader he says:—

“I have shown that when the moon is vertical to St. Helena, she is 2,362 miles nearer to it than to the point called the ‘Land’s End’ in Cornwall; and that as her *reputed* power of gravitation is *not of sufficient force* to raise a tide at the former place, it *cannot* be the cause of the high tide which flows at the Land’s End, particularly since she is in the *meridian* of both places at the same instant, which adds another link to the chain of proofs already given respecting the *negative influence of the moon* over the tides of the ocean.”

Besides this palpable instance of the moon’s exercising no *attractive* influence whatever upon the ocean, I continue from his pamphlet, page 8:—“The *theory of the tides* expressly states, that ‘the action of the moon over the waters of the ocean is the most direct and intense when she is moving in the equinoctial; and, should the times of conjunction or opposition take place when she is so circumstanced, and at her *least distance* from the earth, the tides will be the greatest possible. But, in all cases, the highest tides must take place *within the tropics*; and the nearer any port or harbour is to the equator, the greater will be the force of the tide in such harbour.’

“Now we know from actual experience that there *are no tides* at any of the islands within the torrid zone that are 200 or 300 miles from the nearest mainland. At St. Thomas’ Island, lying very nearly under the equator, in the middle of

the ocean, and free from interference on every side, we find from actual observation that instead of a high tide in that harbour, there is a total absence of anything like a rise and fall of the water, except the *few inches* flux and reflux which keep pace with the alternate returns of the sea and land breezes, the same as at most other islands adjacent to the equator, and that are at a proper distance from the mainland, as already noticed."

Though the moon of necessity must and does exercise some little indirect influence upon the magnetic needle wherever she passes, on account of the electric link which, as it attaches planets and comets to the sun, attaches her to the earth, thereby disturbing,\* to a slight degree, the normal electric state of those parts she is passing over, perceptible also in the epileptic, the somnambulist, and other objects in nature immersed into, or overshadowed by, this link: these facts, and many other valuable remarks of the author, must for ever nullify the theory of her attraction—not even extending to the magnetic needle—of the waters of the ocean. And yet, contrary to these undisputed facts, it has been computed by Sir Isaac Newton, and believed to this day, that the attractive force of the moon raised the water in the great ocean ten feet, whereas that of the sun raised it only two feet; that, when both the attraction of the sun and moon act in the same direction, that is, at new and full

\* This disturbing influence must necessarily vary with the phases of the moon, and be different when the side turned towards us is illuminated or darkened, when our satellite is in opposition or in conjunction, when we receive the fulness of the sun's rays, with their reflection, more or less, by the moon, or when, more or less, she interrupts that fulness of light and warmth, preventing its falling upon the earth, and thereby diminishing his electric influence. Hence also a lunar monthly electric tide, and the different effect on plants and seed put into the ground at different times, as we have seen before.

moon, the combined forces of both raise the tide twelve feet. But when the moon is in her quarters, the attraction of one of these bodies raises the water, while that of the other depresses it; and, therefore, the smaller force of the sun must be subtracted from that of the moon; consequently the tides in *the midst* of the ocean will be no more than eight feet.

Here we have a theory, universally und tenaciously believed, in positive opposition to a well-ascertained fact; and though the fact for ever nullifies the theory, it is well, that, besides the preceding anomalies, others should still be noticed.

According to Sir Isaac Newton, it is the attraction of the earth, revolving by centrifugal force, which keeps the moon in her orbit. Captain Kerigan, on the other hand, maintains, that by calculation, based upon the laws of *universal gravitation*, the moon is *not* retained in her orbit by the mere force of terrestrial attraction; for if left entirely to *that*, she would fly off from the present orbit and be lost upon the body of the sun.

Now if it be true, as no doubt it is, that the earth attracts the moon, the larger body the smaller one, how can it be said, as in the present theory is done, that the moon attracts, or "draws to herself the earth's centre"? It is a perfect contradiction, and this the more so, as their mutual point of gravitation has been laid down altogether outside the body of the earth. If, moreover, the earth have more attractive power than the moon, if it attract the distant moon herself: should not then the earth also exercise more attractive power over its own waters than the moon? Or is it at all likely, that more affinity should exist between the surface of the water and the moon, than between the water and the earth itself, both forming but one body? And as the earth is drawing down the moon, keeping her forcibly in her orbit: is the

moon, in return, thirstingly, as it were, drawing away, and lifting up towards herself, the waters of the ocean? This again, is a pure contradiction, unless it were asserted, that the earth and moon attract each other, like positive and negative electricity, and that the earth throws up the tide-wave to attract the moon. But this would ascribe attraction to the water, which no one ever dreamt of doing. The tide-wave, moreover, is more than three hours *in advance* of the moon, and it has never been asserted that the moon follows in its wake like a cart after the horse. If, on the other hand, the moon attracts the water: do her attractive rays act more powerfully when exercised in the vertical, or more in the oblique direction? According to the positive, unalterable, law of attraction, the action is more powerful in the vertical, than in the oblique line; why then is the tide highest three hours after the moon has left the vertical position, that is: why is it highest three hours away from the vertical line of the moon, and that, too, in *advance* of the moon? This has certainly been explained by the holders of the present theory; but is the explanation reasonable and natural? I think it to be neither the one nor the other.

If a given power is not able to lift up a certain weight perpendicularly, it will not be able to do so in an oblique line. Suppose the body to be drawn up, or to be attracted, to be elastic, very heavy, of great length, as we may consider the water to be; and that, as in the case of the moon, the attracting, or lifting power, is not stationary, but constantly moving forward: it must be clear to the most ordinary capacity, that the body drawn, or attracted, must drag along until it gets into the perpendicular line with the lifting, or upwards-attracting power, and that in all cases, whether the attracting power be able to lift the attracted body from the ground, or not, the object attracted must always follow in the

wake, at the tail of the onward-moving attracting body. But in the case of the moon, the body said to be attracted, is always in *advance*, the cart before the horse.

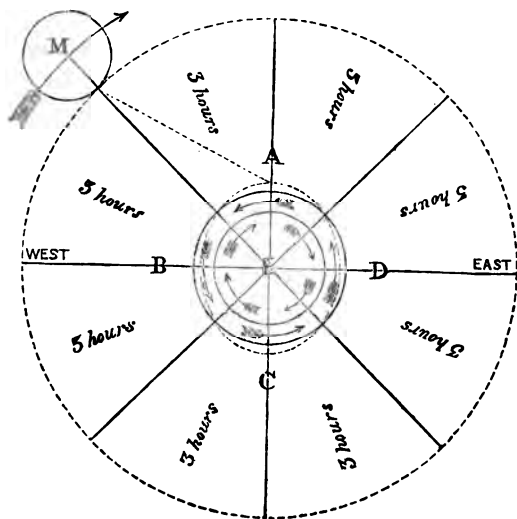
No case can be made out in which an attracted body is, or can be, swung forward, or forced, in advance of the body attracting, except by an extraordinary power, suddenly applied; and this extra power, suddenly applied, would have to be greater if the attracting body were moving on without intermission, as is the case with the moon, than if it were stationary. This, therefore, cannot be applied to the tides. It might, however, be said, that, though the moon does not give a rising impulse to the tide-wave, notwithstanding what is actually taught, this impulse is given by the earth, carrying the water away from under the moon more than twenty-five times faster than the moon is progressing in the same direction in which the earth revolves; but this is not so either. If, upon this supposition the moon drew, or attracted, the water at all, she would have to draw it from the western side, and that too, with a still greater rapidity than that with which the earth revolves, as otherwise she could not raise the water; and *in that case*, the tide-wave would flow from west to east, whereas the current of the ocean, as well as that of the tide-waves, comes from the opposite side, flowing from east to west. If it were contended, that the rapid revolution of the earth has nothing to do with the raising of the tide, or with the pretended impulse given to its wave, on the comparatively quiescent ocean: then the carrying away of the tide-wave in advance of the moon, and the attraction of the moon after the water has gone away from under her, along with the revolution of the earth, falls of itself to the ground.

Notwithstanding all this, and in order to reconcile a forced theory with fact, to establish the moon's attraction in ad-

vance, contrary to the law of attraction being strongest when exercised in the vertical line, it is actually maintained by some, that the moon really does draw the tide in an oblique direction, and this too, on the most simple principles of mechanics. How this is possible, and how it can be reconciled with tidal phenomena, I do not understand.

The earth E revolves from west to east, the moon M goes in the same direction, and the water of the earth flows in the

Fig. 3.



opposite way, as it were, between both. The tide-wave is always on the east-side of the moon, at the same relative distance from her, without any intermission, or change, and flowing from east to west; it is always, according to the divisions in fig. 3,—high water being at A—about three hours and a half, let us say three hours, in *advance* of the moon, though *flowing towards her*.

The tidal wave, moving towards the advancing moon, and

yet permanent in its relative position to her, makes the theory of oblique attraction very plausible, and would certainly remove the anomaly of high water meeting the spectator on the revolving earth, about three hours after he has passed under the moon's meridian, did it not nullify the positive law of attraction, which acts strongest in the vertical line. But apart from this, the question will naturally arise: why should the moon attract towards the east, and not towards the west? Why before, and not after her? Why should she draw water from the east, and not from the west, nor equally from the north and south? If the theory of attraction be true at all, why does the moon, a completely round body, not attract on all sides at the same time towards her own centre, and give us high water under her perpendicular line? The theorists of oblique attraction have yet to prove, that the moon is positive in the east, and negative in the west of her body; that she has a pole of attraction for the *waters* of the earth, not for the earth itself, towards the east; one of repulsion, or negative, towards the west; neutral north and south, and no attractive power at all in her perpendicular, and therefore nearest, line to the earth; and yet upon this totally unwarrantable supposition alone, of attraction on one side only, and that in advance too, can the theory of oblique attraction be maintained.

Drawing in an oblique direction, on the most simple principles of mechanics, it is said: that the moon does not draw the tide-wave all at once, but sheet after sheet, globule after globule; and taking the tide to attain a height of thirty feet during the six hours it is rising, would give the one-sixtieth part of an inch for every second, so that, apparently, the operation would be very easy.

Now it must not be forgotten, that the moon goes faster towards the east, than the waters of the earth are flowing

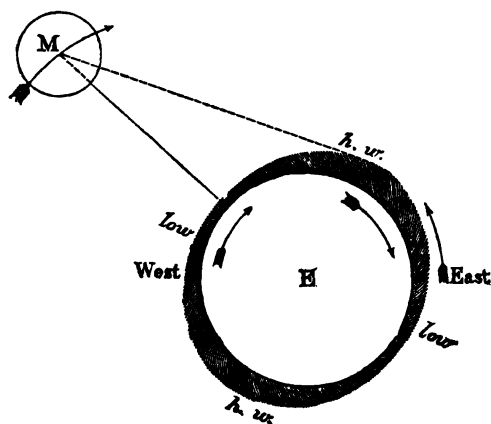
from east to west, like a steamer that ascends the river with greater rapidity, than the river itself is descending; whilst, however, the waters are flowing westward, they *recede away* from the face of the moon at the same time, on account of the daily revolution of the earth from west to east round its own axis; the revolution of the earth carries the waters along with it, but imparts to them at the surface in particular, a movement, or flow, in the opposite direction, that is, from east to west. But, as said before: this westerly current of the waters is not as rapid as the passage of the moon from west to east, though the earth itself revolves at the rate of fifteen degrees per hour, whilst the moon in the same direction, progresses but at the rate of thirteen degrees per day.

Therefore, if the moon were drawing forward a sheet of water over the level of the westward moving, yet eastward receding, ocean, and in succession adding another, and another over another: she could not wait drawing the second sheet until she had finished the first, nor wait for the third until she had drawn the second; for, if the waters were flowing towards the moon at the same rate at which she is moving against the current of the water,—without taking into consideration the revolution of the earth,—the first or preceding sheet would always have moved in advance, away from the next, as the water never stands still; and in order thus to raise a tide, each successive sheet of water would have to be drawn with an ever-increasing velocity and power, so as to render it possible for every following sheet to overtake and accumulate upon its predecessor; and this cannot be accounted for if the moon's power of attraction be always steady and equal. If the attraction of every successive sheet of water were to follow immediately after the preceding sheet had been commenced, then the operation of raising the tide would no longer be little by little, sheet after sheet, as a

person would draw blanket over blanket, or globule over globule, over a constantly-rising incline, as shown by fig. 4; but it would be an uninterrupted simultaneous elevation of the waters, the focus of attraction being exactly at the top of the tide-wave, or high water.

We here have reasoned upon an imaginary case; but if we take the fact, as it really is, that the waters of the ocean, though flowing towards the advancing moon, are yet much

Fig. 4.



more rapidly receding away from her than just now we have supposed them to advance, the raising of a tide-wave becomes still more difficult and improbable, and not at all easy on the simple principle of mechanics. Indeed, it seems to me more intelligible that the moon should lift and keep up the tide-wave, whether perpendicular or obliquely, with one steady uninterrupted effort of the whole power, than that she should draw it by forming sheet upon sheet. This theory, in fact, would make the attractive power of the moon greatest at the greatest distance, confined to the eastern side only, and com-

pletely null everywhere else; the tide-wave once raised, the moon would have to keep it up by supplying it from the most distant eastern point of low water, to the top of high water; and thus, the proposition of oblique attraction cannot for a moment be entertained.

The theory of the tides states, that the water being attracted by the moon, it recedes at the sides of the earth, B and D, figs. 1 and 2, and thus causes the tide-wave on the side of the earth opposite to the moon; but what becomes of this tide wave, if, on the oblique theory, the moon attracts the water on one side of the earth only? This consideration seems entirely to have been overlooked by the theorists of oblique attraction, and is in itself enough for ever to discard this assumption.

We must, then, pass again to the theory of vertical attraction, and once more notice the constant following of the tide-wave three hours after the moon has receded from our meridian, or, which is the same, after we have been carried forward away from his meridian.

I have shown already, and must notice it once more, that the revolution of the earth cannot carry the tide-wave in advance of the moon, as, in that case, it would have to flow from west to east, whilst it flows, with the waters of the ocean, in the contrary direction. Or, if the earth does carry away the tide-wave in advance of the moon: where was the wave first formed? Underneath the moon, or on her western side? It is curious, if, as we are taught, the moon continues to attract the water after the rotation of the earth is said to have carried the tide-wave from under her to the east, because in that case she *must also have begun to attract the water* before it came to her from the west, and thus have drawn it *backward* from its westerly flow, *quicker still* than by the rotation of the earth it is carried eastward; and hence, by

*reason of this necessarily backward draft from its westerly current*,—if it be true that the earth carries away the tide-wave in advance of the moon,—the tide-wave *ought* to flow from west to east; and yet its course and flow is westward. Attractive power itself is not of a sudden, impulse-imparting nature, and for this reason the *attraction of the moon* cannot be of that kind, as to swing the tide-wave, if there were any, from her western to her eastern side. Attraction, moreover, is not a thing that accumulates, like the power of a steam engine, which will be followed by the train, though it should be separated, or have passed away, from it. And if the engine were to be placed at the end of the train, it would no longer draw, or attract, but propel or push it. \

The rays of attraction, supposing the moon to possess them, like the rays of the sun, are strongest in the vertical line; those of the moon, however, do not accumulate on the earth, and least of all, in advance, but they are like ropes, like a plumb-line, by which the moon, in a manner, lifts, as it is said, the water. On the other hand, the rays of the sun do accumulate by refraction and reflection, though they are never so strong as at midday; and this accumulation from the early part of the morning gives us the height of heat in the afternoon, two or three hours after he passed the meridian. Thus, the delay of the tide-wave, following the moon three hours after she has passed from her vertical position, cannot be compared with the delay in the warmer state of the air in the afternoon; it is like a room, which will remain warm for some time after the fire of the day has gone out. But, to compare to this the rising of the tide after the moon has passed, would be expecting the water to rise after you have ceased to pump.

It must, besides this, be borne in mind, how enormous the attraction of the moon ought to be, in order to overcome

the pressure of the atmosphere upon the water, of 15 lb. to the square inch, particularly if on the vertical theory, she causes the wave still to rise for three hours after she had ceased to influence it; for we cannot raise an inch of water ourselves unless we pump, or suck, the air away from over it first.

The earth attracts the moon, and yet, according to the current theory of the tides, the moon would draw up the entire sea, if the air were not between.

According to the exposition of the Newtonian theory of the tides, as explained before, "the water will rise on the side of the earth away from the moon, because the earth's centre is more strongly drawn towards the moon than the point A, and recedes from A, which is the same in effect, as if the water at A receded, or rose up from the earth's centre."

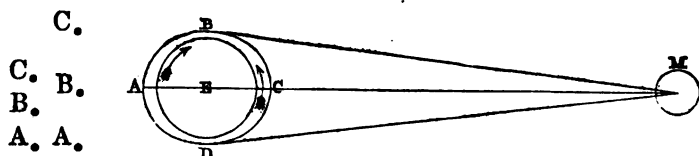
Now if this were the case, that the side of the earth away from the moon leaves the water behind: would it not be more natural still, that, the earth's centre being so strongly attracted by the moon, the water facing the moon should give way on all sides to the pressure of the atmosphere, and cause the solid earth to peep out like a ball drawn out of a basin of water, rather than allow the water to accumulate upon it? A momentary attraction might cause a momentary swell, but permanent attraction is permanent rest.

If the moon is able to "draw towards herself the earth's centre," I beg to ask, on the strength of this law: at what time does she do so? At what time does she relax her hold? For, if the *constant* production of the two tide-waves depended upon this attraction of the earth's centre, the moon would have to attract the earth powerfully and *without intermission*, and this would be drawing it out of its sphere, and ultimately bringing them both together; and if this result were not to follow, it would completely neutralize the attrac-

tion, and there would be no attraction at all; and for the moon at any time relaxing her hold, would be equally nullifying the theory. Nor can the proposition of the moon's attracting the earth's centre be true, if, as it is said also, the moon exercises more power over the water than over the earth.

But this last proposition, illustrated in the following manner, cannot be true either. A, B, C, are close to, and equally distant from, each other; they are travelling towards a certain point; but C walks faster than B, and B again faster than A; the consequence is, that when C arrives at the point, B is left much behind C, and A is more left behind B; and this is applied to the tides. In the following diagram (fig. 5) the moon M attracts the water at C more

Fig. 5.



strongly than at B, and at B more than at A; the water at C is consequently raised with velocity, depressed at B by being drawn away towards C, and raised at A by the very *want* of velocity; or, as the illustration has it: C goes faster than B, and B goes faster than A.

Now this certainly seems very plausible, but would, if true, stand good merely for the time when the moon was created; this *might* have been the first operation for producing the tides; but, when once set in motion, C would no longer go faster than B, nor B faster than A; thenceforward they would travel with *equal velocity*, or if the proposition were true, C, B, A moving in a circle, C could soon overtake

A and gain upon B, and B would overtake A also, and the three ultimately be lost one in the other.

If the moon attracts B, D, equally at the same time, she anticipates, or hastens, the flow of water coming from the east, and retards, or holds back, that of the water going to the west; and this operation would give us high water at C, immediately under the moon, *which is contrary to fact*; and if, on the principle of oblique attraction, the moon draws only at C, D, anticipating, or quickening the flow of water on her eastern side, the illustration becomes still more untenable, apart from the certainty, that want of velocity will not make water rise, nor raise the tide, though it had not to contend against the even pressure of the atmosphere. Thus, in whatever light we view the theory, we meet with nothing but anomalies.

What has been said of the attraction of the moon, is equally applicable to the attraction of the sun. If, by this means, he causes the tide-wave to rise, his attraction must then not only be more powerful on the water than upon the earth, but so strong, as to raise the water in opposition to the whole atmosphere pressing upon it; or, the sun must attract the air and water at the same time in a peculiar manner. If the sun attracts the earth itself with a kind of violent effort, then the fluid water, and the still more fluid and elastic air, would give way to the forward impulse of the solid earth, and cause, as with the moon on the same supposition, low, instead of high water. If the sun and moon attract our globe, including its water and atmosphere, in an equal manner, as one whole, then they cannot cause the raising of the tide; the effect of the attraction upon the water would be the same as if there were no attraction at all.

If, in theory, the attraction of the moon is sufficient to raise a high tide on the open ocean, why can she not raise a

tide in the Mediterranean, or Baltic, and other smaller inland lakes? "In small collections of water," it is argued, "the moon acts with the same line of attraction, or nearly so, upon every portion of the surface at once, and therefore, the whole of the waters being equally elevated at the same period, no part of them is ever higher than the other."

But then, the same takes place in the open sea; "there the moon acts with the same line of attraction upon a similar portion of surface," beyond which the waters, by degrees, cease more and more to be under her influence; and yet it is said, "that in this wide expanse of waters she raises up the parts immediately under her," which is equal to saying, that a loadstone attracts a large piece of iron better than a small one. "The moon raising up the parts of water immediately under her," that is, in her perpendicular (which is against fact) the depression at the sides naturally *follows*; but this depression does not, as we are told it does, assist the raising, it cannot be cause and effect at the same time; and this raising, moreover, can only be supposed to be done, by the moon's rays of attraction being concentrated in one focus immediately underneath, or, by their being more powerful there than everywhere else; and in either of these cases, she would as strongly attract when above the Mediterranean, or Baltic, as when above any portion of the open sea. And this, moreover, would be less striking and wonderful to us, than "that the whole of the waters should be equally elevated," particularly when we consider, that this *equal elevation at the same period all over* is not observable at the islands, or the shore, and that the water is not elastic, and consequently incapable of such an equal, imperceptible, and incomprehensible elevation.

If, besides this, the theory of the attraction of the moon, as applied to the absence of a tide in the Mediterranean, were

correct, we should have no tide on any of the shores of either the Atlantic, Indian, or Pacific Oceans.

It has, to my knowledge, never been calculated, how many Mediterraneans it would take to enable the moon to raise a tide. If this sea had a tide of but one foot, we might make out, that a sea ten times the size, or less, would give a tide of ten feet, or more; but, the moon having *no tidal influence whatever* on *one* Mediterranean: how many Mediterraneans are to be added before such influence begins? How many more, before such influence becomes perceptible? And how many more still before such influence will draw a tide of ten feet only? Suppose that it would take ten or twenty times the space of the Mediterranean to render the attraction of the moon upon the water perceptible, or to enable her to draw a tide of a few feet; she would then, on passing from one shore of the Atlantic to the other, not begin to exercise any perceptible influence on the water, or draw up any tide, unless she had passed over a space more than ten or twenty times that of the Mediterranean; and on arriving at the other side, the tide would pass away, and her influence again become null, as soon as she should have got within the same space from the land. The tide-wave, upon this theory, would begin and increase with the distance of the moon from the shore, and, AGAINST FACT, be highest in the middle of the ocean, where she would have abundance of surface to raise a tide. If, indeed, in the middle of the ocean she were to raise a tide of 100 feet, she would draw the water from such an immense extent of surface, as not to require one drop from the shore; but, apart from this, the highest tide in the middle of the ocean, if there were one at all, would precisely be as imperceptible at the shores of the Atlantic, as at the shores of the Mediterranean, inasmuch as the influence of the moon would as imperceptibly cease, and that too at the

same distance from the shore on the one side, as it began at the other. Like a hill of sand in the middle of a desert ; it may be raised and scattered without any sensible effect on the level, and without the slightest encroachment on its borders.

It is almost impossible to notice all the arguments which have been had recourse to to prop up the Newtonian theory of the tides ; every one has tried to explain a simple fact, but no explanation is found fitting. It is, on the other hand, more troublesome to prevent an old house from falling, than to build up a new one ; to refute fallacies, than to establish a truth. Therefore, without entering further into the contradictions of the present, I will now proceed to state my new and most probably

#### CORRECT, THEORY OF THE TIDES,

hoping, that in abler hands it will solve all the difficulties that may as yet be found to exist.

God's will, by fixed laws, governs the whole universe. These laws are arbitrary, but cease to be so to our understanding, when we are able to account for their operations ; by them He guides the heavenly bodies, as the will of my soul guides my pen, moves my limbs, and rules my whole frame. So then, it is the will of God, that this earth should be girt by the ocean, that its waters should neither displace the air and fly off to the moon, nor be absorbed by the bowels of our globe. So it is the will of God, that this earth should be enveloped in a fluid, called the air ; that this mixture of the air should have no tendency towards the centre of the earth, but withdraw, and keep away from its pits and subterranean cavities, nor a tendency to escape beyond our sphere, as proved by its rarity in the upper regions. It was His will, that this ocean of air should constantly flow round, and cover, our globe ; that above this

ocean, called the atmosphere, as a matter of extreme probability, if not necessity, and as I have tried to prove already, there should be a still clearer and purer element, commonly called ether, but which, as I have demonstrated before, is almost beyond doubt, an ocean of oxygen; and that above this ocean of oxygen there should be other oceans of still more subtle and elastic fluids; that somewhere above one of these oceans, destined like these, and like the water and the air, to remain in the space assigned to her by God, and like a ship on the sea, there should appear the bright moon, *as a light to the earth*, as the beneficial agitator of the oceans of matter beneath, her upper part enveloped, perhaps, in a substance quite different from that in and upon which her lower part is immersed and floating.

Be this, however, as it may; whether two, three, or four oceans, or rings, of different matter, separate us from the moon: for the peculiar purpose for which she was created, God placed her, gravitating to the centre of the earth, on one of the oceans above us, not like a revolving planet, like a revolving wheel, but like a well-laden ship on the sea which she has to traverse; on this ocean she performs her journey round our globe, according to the laws of which I have treated before, always presenting to us part, or the whole, of her hull, without our ever, like a fish in the water, beholding the deck or the masts.

The theory that the moon rotates round an axis of her own, is a totally false assumption, based upon the idea, that a body moving in a circle, and a body forming the centre of a sphere or a circle and moving on its pivot, is one and the same thing. If this be proved not to be true, the controversy must naturally be at an end. It is only to be regretted, that in so simple a matter, so many words should have been, and have to be, wasted.

The earth rotates 365 times round its own axis, whilst performing one revolution round the sun. If the earth, in its revolution round the sun, did not rotate round an axis of its own, one side of it only would ever be presented to the sun; if it rotated but once a year round its own axis, every part of the earth, during that year, would once be presented to the sun.

The moon and the earth occupy the same relative position. If the moon turned but once round her own axis during the month, every part of her would once be presented to the earth during that month; but as the moon does not rotate upon an axis of her own, so but one side of her alone is for ever presented to the earth.

A body moving in a circle, and keeping with the same side, or the same face, the axis, or centre of such circle constantly in view, would be *subject to the condition of non-rotation*. If without intermission you will keep in sight a fixed, or central, object, whatever the line you move in, your non-rotation becomes a condition. The same face of the moon, the same lower part of a balloon, the same bottom of a ship, keeping the earth, the centre of their circular orbit or motion, constantly in view, their non-rotation round an axis of their own, round a centre within themselves, becomes a condition.

Thus, to the inhabitants of the earth, the moon does not seem to, nor does she, rotate round an axis of her own, because they always see the same face; but to the sun, it is argued, she does rotate round an axis of her own, because in turn she presents to him every part of her surface.

A little consideration only, will show, that to the sun even, the rotation of the moon round an axis of her own, is but apparent, supposing the inhabitants of that fiery globe to hold the contrary doctrine.

Moving in a circle, without the earth round which to

revolve, the inhabitants of the sun might easily be misled respecting the rotation of the moon round an axis of her own. The space described by the orbit of the moon, might, to their eyes, be quite inappreciable; they might consider her rotating on her own axis, subject to certain changes of position in the heavens. But when they see her move round another dark body, they will at once conclude that she does not move on her own pivot, but in a circle, round the centre of that circle. They would see that there is no rotation, but a simple floating motion round the earth. Let the moon gradually sink down towards the earth, towards the centre of her gravitation, and by degrees the interior part of the circle, the *face which we now see*, will be hidden from the sun; let the moon finally float close to the earth, or ride upon the mountain tide she will then have raised by her attraction (!!) and nothing but the part away from us, the *only part seen by the sun now when in conjunction*, will ever be beheld by his inhabitants, and that also but once a month only. The moon to them will then, like the ship, be nothing but part and parcel of the earth which she really is, with this characteristic, that she would present to him her deck, her sun-turned face but once a month, whilst the earth presents to him the same face once every day, and that for this reason: that the moon is too heavy and the fluid upon which she floats too light, to enable the earth to carry her round with it, on her present ocean, within the time of its own rotation.

The axis of the earth, then, is the axis of the moon's rotation, and this truth no distance from the earth can change. Then only, if the moon were substituted for the earth, it could be said that she rotated round an axis of her own.

A ship sailing round the earth is in exactly the same

condition as the moon; like her she always presents the same face to the centre of the earth, and consequently does not rotate round an axis of her own, but round that of the earth to which she belongs; remove her to the distance of the moon, and nothing will change her law of motion; she only is further removed from the centre of her orbit, from the solid body round which she floats.

Ship or moon, or balloon, whether floating on the sea of water, of air, or of ether of our earth, behold every quarter of the globe the same as the earth itself; but it does not follow that for this reason, as it is argued, they should also move round an axis within themselves, round an axis separate from that of the earth; to suppose this, would be a manifest absurdity, because, in fact, they are nothing but part and parcel of the earth round whose axis alone they revolve.

A different thing it would be with the wheels of a carriage drawn round the earth. Whilst no one would say that the carriage, presenting always the same inferior part to the earth, to the centre of its gravitation, was rotating on an axis of its own in going round the earth, everybody would be obliged to acknowledge, that the wheels by themselves, during the same journey, would make many revolutions round their own respective axes; but, put drags to the wheels, and in that instance rotation round their own axes would cease, because, like the moon, the ship, and the carriage, they would always present the same part, the same face, to the centre of the earth. The test of the rotation of a body must, in fact, be taken from the point or centre of gravitation round which such a body moves, by which it is attracted. If, for instance, *vis-à-vis* the sun, the moon were to present to him always the same face during her orbit round the earth, it would amount to non-rotation; hence, astronomers say, the moon

*does rotate* on an axis of her own because the above does not take place. And yet, the case stands quite different. We do not, in the first place, know of any motion of a body like the one supposed, moving in a circle or orbit, without this circle or orbit having an axis, its point or centre of gravitation; the motion, in fact, according to the laws of nature, is simply impossible, except to an intelligent or living creature. The moon, in the second place, would, on the above supposition, present every part of her surface once a month to the earth, and this really would be one rotation round her own interior axis during one of her revolutions; but, this not being the case, non-rotation is established as a matter of course. Body and axis are equally attracted by the centre of gravitation; body and axis never change their relative position; both, like the clogged wheels, present always the same part to the centre of the earth; and wherever a body and its axis present always the same face to the centre of their gravitation, though that centre be only the axis of a silken thread round which they move, *there is non-rotation*; and to a spectator, or body, outside the circle of such motion, the rotation would be in appearance only.

Before the drags were applied to the carriage-wheels, they had a double motion like the earth; the one motion in a circle round the earth, and the other round their own respective central axes. When clogged, the wheels made a simple revolution only round the earth, they simply moved in a circle, and rotated once round the axis of that circle.

A circle, then, *must* have an axis; a body simply moving in a circle must naturally move round such axis as its centre, the same as in drawing a circle one leg of the compass moves round the other as its rotating centre, though, like the earth round the sun, like the unclogged wheels round the earth, such a body may at the same time rotate round an axis of its

own. In the latter case, the rotating body does not with the same face, with one particular part of its surface, keep the axis of its circular motion constantly in view; and this is the test of its rotation. The moon in her circular orbit, the ship, the carriage and the clogged wheels, in their motion round the earth, do with the same face always look to the centre of the earth, and hence the test of their non-rotation.

A central body, in order to keep another body moving in a circle around it, constantly in view, whether with a particular or any or every other part of its surface: rotation round its own axis becomes a condition. Hence, moving simply in a circle, and moving in, or upon, a centre, forming a moving centre, are two different motions, though both may be combined. That they are not so combined in the moon, and that she does not rotate round an axis of her own, I think I have sufficiently proved; and no experiments will establish the contrary, unless they grapple with the special arguments, and disprove the illustrations, I here have used.

From the coincidence of the exact time of the tides, with the exact time of the progress of the moon round the earth, in connection with the rotation of the earth round its own axis, there can be no question but that they are occasioned by the moon, contrary to the idea of Capt. Kerigan, who believes her influence to be entirely negative. Now, if we substitute "pressure" of the moon for "attraction" we shall be able easily to point it out as the cause of high and low water.

It seems natural, that, like a ship on the sea, or a boat on a canal, the passage of the moon over the ocean of matter in which she swims, should produce a pressure, and a corresponding expansion at the sides. This pressure upon the said ocean, we will call it ether, acts directly, or indirectly, upon the air, the same as the pressure of the air acts upon the

water ; and the nearer the moon, the stronger the pressure, and the further away, the less her influence ; like the pressure of a ship according to the width of the river, and her distance from, or nearness to, the shore. The pressure will also be influenced by the greater or lesser rapidity with which the ship is progressing.

We all know the corresponding effect of the wind, or of an agitated atmosphere, upon the water, in causing the rise of waves. The agitation of the atmosphere itself is caused in a variety of ways, partly known, partly unknown, into which however, I here cannot enter ; but I have shown already, on treating of thunderstorms, with what force the lowering cloud presses upon, and displaces, the air beneath it. The passage of the moon, however, is more than the lowering cloud, though her pressure seems to be unfelt, because so even and so far extended.

That, apart from winds, and the various currents in the air, there is a regular current, or movement belonging to the whole of the atmosphere, is proved by Humboldt. In his "Cosmos" he says : "One of the main features of the atmosphere is the variation of the pressure of the air between the tropics, a regular, so easily discernible, hourly oscillation, a kind of ebb and flow, of the atmosphere, which is not to be ascribed to the attraction of the moon, and which very much varies according to the geographical latitude, the seasons, and the height of the point of observation above the level of the sea." In another place he speaks of "the hourly variations of the atmospheric pressure, which successively take place from east to west, and which in the tropics are so regular."

Whence, then, comes this regular ebb and flow of the tide of the atmosphere ? It does not result from the *attraction* of the moon, as Humboldt truly observes, nor from any cause operating on the surface of the earth, no more than

the tide of the ocean is caused by some operation at the bottom of the sea. If the surface of our atmosphere were as tangible to observation as the surface of the sea, I have no manner of doubt, but that the tide of the air, in all its features, would resemble the tide of the sea, particularly after what is said by Humboldt of its variation according to place and season.

This, and that the tide, both of the sea and the air, successively takes place from east to west, renders it still more probable, that the tide of the sea is but the effect of the tide of the air, and that both are caused by the *pressure* of the moon.

My new theory of the tides seems to me, in the highest degree, to be the true one, inasmuch as it requires no forced application, and is simple, without any contradictory points between law, theory, and fact; and because it solves all the anomalies which cannot be reconciled with the theory of Newton. I do not think, for instance, that it is overstraining my reasoning, if I account for the two opposite points of high water, and the two intervening opposite points of low water, in the following manner:—

It is a well-known fact, that, apart from particular currents, produced by particular causes, the general flow, or motion, of the air, as well as of the waters of the sea, is from east to west, the same as their tides; and this flow from east to west, with Galileo and Kepler, I ascribe to the rotation of the earth in the opposite direction, from west to east. The moon, sailing, as it were, in the same direction, from west to east, though across the earth, goes against the currents of water and air that flow on the earth from east to west. By her pressure, direct or indirect, upon the atmosphere: the air, an elastic body, is depressed and displaced underneath, and raised in front by her onward course against the contrary

current. The first tide-wave is thus created immediately in front, or to the east of the moon; and the air, escaping behind, will rise as much, or nearly so, beyond its ordinary level, as it had been depressed below it, and thus cause the formation of the second tide-wave, on the western side, and at a greater distance from the moon than in front. These atmospheric tide-waves will press upon the water, and present to us the tide-waves of the ocean in a corresponding manner; the pressure of the moon, extending in its effect over at least one fourth part of the earth, each of the tide-waves will cover a similar space, leaving between them, immediately under the moon, and, by the very want of velocity, also on the other side of the earth, opposite to the moon, one fourth part each of low water.

Or, the moon may also be considered a floating bridge; the ethereal current strikes against her bulk, is arrested and accumulates, then forces its way underneath and over, like the air through the arches of, and over, a bulky bridge, and rises and accumulates again on the other side in proportion to the disturbance of its level. And this disturbance of the ethereal level acts upon the air, and the air causes the tides of the sea.

As the height of the tides of the sea is influenced by shallows in the sea, by the configuration of the coasts of the mainland: so the variation of the ebb and flow of the air depends much on the chains of mountains it has to pass by, or over, and on the nearness, or distance, of the moon from such coasts or mountains.

I will now try to reconcile a few anomalies of the theory of attraction, with my new theory of pressure.

If the attractive power of the moon is not sufficient to raise a tide at St. Helena, whilst it is said to be the cause of the high tide at the "Land's End," which is not east of the

moon, but on the same meridian with St. Helena : then this anomaly disappears by substituting the *pressure* of the moon for her *attraction*.

A ship on the water will displace as much water as her bulk is immersed in, and the pressure of the ship on the water underneath will not be greater than that of the water which she displaced, inasmuch as the water displaced is equal in weight to the body that has taken its place. But the pressure of the ship will force the water displaced to the sides, and manifest itself in a rise at the shore to which it is driven, supposing the ship to be large, and the channel narrow, enough for the purpose. A boat going at a fast rate on a canal, will, by her onward pressure, raise the water at some distance in advance ; and the water, from being depressed, will rise again some distance behind the boat, and then find its level.

The moon is nothing else but a ship, a boat, to which the ocean is as a large river, and gulfs, bays, and rivers, are as canals ; the elastic air readily gives way to the pressure of the moon, to the pressure of her weight, and therefore exercises but little, if any, influence on the water directly underneath ; but it accumulates in a wave, increased by the onward pressure of the moon, and weighing upon the water at a distance, makes it rise on the shore. Hence the imperceptible change in the ebb and flow of the water at St. Helena, though the moon be there in the zenith, and the high tide at the Land's End so far away. Hence also *no tides* at any of the *islands* within the torrid zone. Islands, at the same time, are to the flow of water what single hills, or solitary mountains, are to the motion of the air ; they are not sufficiently broad, unless the flood be very rapid and strong, to offer any perceptible resistance, to be an obstacle to its course ; they simply divide the approaching current,

which has time and space enough to pass and expand on either side, without rolling up the shore to any tidal degree.

By my theory, the anomaly of the tide-wave continuing to rise, by impulse, or by continued influence, for three hours after the water has been carried away, by the rotation of the earth, from under the vertical line of attraction of the moon, as well as the theory of oblique attraction, is solved without difficulty; for, by the double pressure of the moon, that of her own weight and that of her onward course, she *does* give a propelling impulse to the water, which will continue to flow, and to rise at the shore, *though* she has long passed away; and the greater the pressure extends into distance, the greater the accumulation of the wave; and the shorter the distance, the lower the tide.

According to my theory of pressure, the rising tide has no super-incumbent weight to overcome; the water is like the scales of a balance, of which the one will not rise, unless the other is *pressed down by weight*. And with the tides it is still more necessary, that one scale should *sink first* by accumulated pressure, and thus cause the other to rise, because the weight of the atmosphere is precisely equal all over the ocean; and the ocean being entirely covered and pressed upon by the air everywhere, the weight of the *atmosphere will* prevent the rise of the tide, unless the moon, in *attracting* the water, is powerful enough to attract, or draw up also, to displace, or overcome the resistance of the air. The work performed by the ocean in rising against the atmospheric pressure, is precisely equal to the force exercised by the accumulating influence of the moon, the pressure of the air-tide, on the portion which it causes to sink. The phenomenon of the tides is the result of weight, of water *thrown*, not *drawn*, into motion, by an external force ever varying, both in direction and amount; and this external

force is beyond all doubt the pressure, and not the attraction, of the moon ; it is, as it were, the rocking to and fro of our atmosphere upon the ocean. The loftier ocean of the moon is not free from agitation either, and as its waves are rocking to and fro, she oscillates likewise, so that at one time we see more of one or the other of her sides than at another, and this is called the libration of the moon.

Respecting the absence of tides in the Baltic and Mediterranean, it is easy to conceive, that the continents of Europe and Africa, their mountain chains and configuration, may prevent the tide-waves of the atmosphere having effect upon these seas, or, that they are already *beyond* the influence of the moon. This influence, however, would exist, if the Mediterranean, for instance, were connected with the southern ocean by means of the Red Sea ; it would then most certainly have tides at the place of junction, if not all over. But the chief cause, no doubt, is this : that these seas are too small to allow the motion given to the water by the gentle pressure of the moon, to accumulate into a very perceptible tidal wave by the time it reaches the shore ; for, it is natural, that, the smaller the sheet of water, the less time and material there is to raise a wave, or tide, at the shore.

When the moon is in conjunction with, or opposition to, the sun ; when she either receives the full reflected light of the earth, or the earth receives that of the moon, her pressure is the greatest, because, in her passage round the earth, she happens, at that time, to be not only nearest, but also travelling with greatest velocity. For, according to observation, the true velocity of the moon becomes always greater, the nearer she herself comes to New and Full Moon, or, within the ecliptic ; and at these points of her orbit she obtains her maximum, as in the two quadratures she moves with her minimum of speed.

The distances of the moon from the earth, from observation, do not agree with the theory of a purely elliptical motion, for, these distances are always less at New and Full Moon, and greater in the quadratures, than they should be, but I hope, that my new theory of the solar system, and particularly the theory of oscillation of the earth, will, in time, establish the orbit of the moon on a clear and firm basis.

If it be contended, that the moon does not float within our sphere, but that the pressure of the moon upon our atmosphere, and its effect upon the sea, is the result of her being *attracted by the earth*: this would not alter, but confirm, my theory; for, this attraction must produce pressure upon the matter between the moon and the earth—as there is no vacant space—and this pressure, as we have seen before, is strongest at the time of opposition and conjunction, the time of their greatest approximation.

The oscillations of the earth will, no doubt, serve to explain the various distances of the moon from us at various times; they will, as also the expansion and contraction of our atmosphere above, materially influence her position, being, as it were, part and parcel of our globe, without any rotating or revolving agency of her own. She is like a huge piece of coke: all her vitality burnt out, save as much as will keep her afloat within certain limits, and gravitating to the earth.

The earth itself would be like a piece of coke, like the moon, if the electric power within were to explode and break through the bonds which hold it confined; it would, as it were, be a floating, lifeless body, if by the burning and wasting influence of the liberated and enkindled elements it were to be deprived of the momentum, of the spring that gave it diurnal rotation, that imparted warmth and fertility

to the whole frame, the same as blood does to that of living beings.

If the veil of the earth were contracted, or removed, the moon would come down upon it. Or, the moon would burn and be blown into a thousand fragments, if, like the earth, she were inflated with the electric fluid.

It is the same with the earth itself, as well as with all the planets. If my theory be true, that, when the sun was placed in the heavens by the Eternal Word, the planets began to rise and to ride on the expanding matter of his atmosphere, or were wafted into it by the same omnipotent power: so, by the contraction or removal of this attenuated atmosphere, they also will be affected. Thus, when at the last day, with the breath of Omnipotence, God will blow out the light of the world, a universal chill and contraction will take the place of warmth, expansion, and life; and there will come to pass, according to the laws He laid down, what the Creator of heaven and earth Himself predicted: "The sun shall be darkened, and the moon shall not give her light, and the stars shall fall from heaven, and the powers of heaven shall be moved." And from the darkness and universal chill, the evaporation of electricity of the earth will be stopped, and the confined element,—which throws the bowels of the earth into convulsions, which, when working under water, often of a sudden rolls mountains of water over devoted cities and places, opening the abyss of the deep and the yawning chasm on land, to engulf the ship and swallow up the habitations of man,—will then, with terrific thunder burst forth in millions of volcanoes on land and water, with the rapidity of thought search the intestines of the sea from pole to pole, in length and in breadth, and from its unfathomable depth throw up heaven-high millions of surging fountains; fearfully lighting up darkness, it will pour

out, from its newly-opened craters and outlets, electric fire and molten lava in streams so incessant and enormous, that the ocean itself will evaporate like a drop of water on a heated plate of iron, and that, in the words of St. Peter, "the earth be consumed by fire;" and at the approach of all this "there will indeed be distress of nations by reason of the confusion of the roaring of the sea and the waves."

But, we need not go to the end of the World for the confirmation of the operation of these laws. A slight, but awful, instance of a mere, as it were, momentary, obscuration of the sun, was witnessed already at the crucifixion of our Lord. When, at that momentous sacrifice of the atonement, the heavenly Father threw a veil of mourning for His only-begotten Son over the orb of light; when horror-struck at the awful crime which was being committed, the sun was paralysed, its life blood chilled and the evaporation of electricity stopped: all became dark, cold and dismal, the earth expanded and trembled, its bosom heaved from sorrow, rocks were rent, and the waters of the earth threatened to overflow the land. And though no electric fire issued from the rent on Calvary, yet, about the same spot, at the right time and place, it broke out from the quaking earth, in fiery balls and flashes, when there was question of destroying the works for the third temple which was being built at Jerusalem under Julian the Apostate, with the avowed object of nullifying the prophecy of Christ, and taking away from his Church the foundation which on Calvary He had laid and sealed with His blood.

There are yet many more subjects connected with my New Theory of the Solar System which would require particular notice, and many which especially and more favourably would elucidate it; but, as an amateur in Natural Philosophy, I have not the facilities, nor time, to prosecute this agreeable

study with that continuity and perseverance which it requires. I hope however, that the reader will agree with me, that my conception of the Solar System is more simple, more consistent, and consequently more natural and true than the theory at present received.

Whether God projected the heavenly bodies in straight lines, and curved their path by the reputed law of universal gravitation ; whether they were dropped by His omnipotent Will into their respective centres and orbits ; whether, as I believe, by electricity moulded out and separated from chaos, they first formed little specks of matter in the blank of space, and, themselves conceived by the thought of God, suns gave birth to planets, and planets to moons ; or whether at once they were created as they are, with the unquenchable electric fire within, surrounded and kept enclosed by a vault, by a crust, entwined of gold and silver, copper, iron, coal, and layers of stone and clay of every description, harmoniously bound and blended together, but subject to superficial changes, according to the designs of God in regard to man :—no mind can fathom the First Cause, how from the depth of His Godhead the Almighty called everything into existence ; the Eternal Wisdom spoke, and, in the language of a divine, chaos heard tremblingly the voice of its Creator, and separated the newly-ordained bodies. At His call, not only our sun, but suns without number, enkindled in the night of the spheres of creation, and to millions of stars and planets He assigned their course. *His will* became order, beauty and wonder throughout the whole sweep of creation ; suns cast their light through the darkness, and adoring worlds coursed around them in their illuminated paths ; the whole new creation became a *mirror of His eternal Godhead, and the manifestation of His self-existing Glory.*

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